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The Development of Digital Collection Platform under Responsible Innovation Framework: A Study on China's Non-Fungible Token (NFT) Industry

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Abstract: The combination of non-fungible token (NFT) with paintings, music, games, videos and other forms of creative content is an innovation to protect the copyright of authors. It digitizes physical works with unique labels. At present, the NFT industry is blooming in the area of digital collections in China, attracting increasingly more artists, art collectors and platform enterprises to interact. However, the NFT digital collection platform is facing challenges and growth limitations. This study adopts the theory framework of responsible innovation. Through semi-structured interview and secondary document review, it analyzes the positive and negative effects of China's NFT digital collections alongside technological, economical, ethical and social dimensions. The paper proposes four development paths to achieve responsible innovation of this emerging new business. Further discussion links NFT with open innovation dynamics, alongside areas for future research.



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Keywords: responsible innovation; non-fungible token (NFT); digital collection platform; platform innovation

1. Introduction and Background

The year 2021 marked the beginning of the metaverse, as well as the rapid growth of the non-fungible token (NFT) business in China. As a new concept and sector, NFT originated from the USA in 2014 alongside blockchain technology, which can be associated with a particular digital or physical asset. However, the exact elements of NFT are yet to be revealed. In fact, there is no standard definition from policy makers, business practitioners and academia, making it difficult to legitimize this sector. NFTs by their nature are digital assets, which are non-replicable and non-interchangeable [1]. Globally, the technology advancement has reshaped the industry chains [2]. Meanwhile, the market immediately witnesses the emergence of innovative activities and projects that combine NFT with images, games, videos, artworks, etc., of which NFT digital collections account for the largest proportion [3].

Generally, NFT in China is referred to as digital collections. The company Alibaba considers it as virtual digital goods, whereas Tencent regards it as virtual proof of rights and interests. The Dachang platform organization emphasizes that digital collections are virtual goods, and once exchanged, they cannot be returned or exchanged. Meanwhile, data collection platforms are seeking for strategies to attract online transfer and user engagement through the secondary trading market to achieve a sustainable economic development. However, the digital collection market is highly dynamic and unpredictable. For example, the market positioning is still unclear. Small platforms are facing the risk of operations interruption. Without investing experience, young investors can be in debt in the digital

collection market. Consequently, whilst the digital collection platform aims to innovate and develop, there is also a need for responsibility and sustainability.

Based on the above background, this paper answers the following research question: How can China's NFT digital collection platform achieve sustainable development in the context of responsible innovation? Specifically, by analyzing the performance of China's digital collection platform, our paper discusses the effects of the digital collection platform from technological, economical, ethical and social dimensions mainly based on Met et al. [4] and Mei and Chen's [5] responsible innovation framework. It also aims to propose the development paths of the NFT digital collection platform.

The remainder of the paper is structured as follows. After this section of introduction, the second section is the literature review of responsible innovation and the research setting of the NFT industry in China. Section 3 details the research methodology. Findings are elaborated in Section 4. This is followed by further discussion on the development path of NFTs, as well as the link between NFTs and open innovation dynamics in the Discussion and Conclusions section, Section 5.

2. Literature Review and Research Context

2.1. Responsible Innovation

The concept of responsible innovation was first introduced in Europe and USA from a policy perspective. In 2003, the USA government issued a science and technology research policy in nano science and proposed responsible innovation, pointing out that it is vital to improve the positive impact of the emerging technology and control its potential hazards, in order to maximize the responsibility for social development [6]. To advance the concept, the European Commission generated the responsible research and innovation scheme, and further articulated responsible innovation in the Horizon 2020, that is, to achieve collective management of current science and innovation based on future goals [7]. It is believed that scientific research and technological innovation must effectively reflect sustainability and social needs [8]. Thus, innovation should be performed alongside acceptable morality, satisfaction of social expectations, safety and sustainability [5], with a new paradigm emphasizing responsible innovation gradually taking shape.

In terms of the elements of responsible innovation, a conceptual framework consisting of anticipation, reflectiveness, inclusiveness and responsiveness is identified [7]. Specifically, anticipation [7] requires upstream public engagement [9], constructive technology assessment [10] and real-time technology assessment [11]. The meaning of reflexivity [7] is about technology assessment [12], intuitional reflexivity in governance [7] as well as rethinking of moral factors [13]. Inclusion [7] is beyond stakeholder engagement and is about engagement with the wider public [14]. Furthermore, the character of openness is highlighted in inclusion [15]. Responsiveness [7] require a capacity to change, seeking for emerging perspectives, views, norms, knowledge and values. It is believed that these four dimensions should be integrated as a whole, mutually reinforcing one another [7]. The motivation of responsible innovation may vary [16]. Some researchers regard inclusion as a way to align products with industry interests, while others emphasize its linkage with the public good [16]. Nevertheless, it is believed that to achieve responsible innovation, collaboration is required to reflect social values and social responsibilities [17–20]. Moreover, global governance schemes are needed, including voluntary soft-law regulations and hard-law regulations [21]. In fact, a policy initialization along with bottom-up engagement can facilitate effective anticipatory governance and inclusiveness [22].

The research into responsible innovation in China started in 2012, when the 3TU–5TU International Conference on Science and Technology Ethics was held in Dalian University of Technology. The features of Dalian Port are summarized in terms of the ethics of artificial intelligence [23]. This is further described as the responsible innovation model of Dalian High-tech Park [24]. There are studies on the innovation practice of China Wireless Valley highlighting artificial intelligence ethics and agricultural ethics [25]. Inspired by the EU science and technology policy, the theme of policy transformation of technology ethics in

China is explored in the area of forest tree transgenic technology [26]. Mei and Chen [27] elaborate the concept, framework, policy enlightenment and connotation of responsible innovation from the time-domain perspective. Furthermore, the attitude of innovative actors towards innovation social responsibility is emphasized [28]. Meanwhile, studies combine responsible innovation with scientific and technological talents, high-tech enterprises, nano drug design, supply side reform and technological philosophy in China [29]. Responsible innovation governance is also investigated in the context of China's shared bicycle sector [19,20] with the application of the anticipation, reflectiveness, inclusiveness and responsiveness dimensions [7]. Findings reveal that collaborative governance can improve the performance of responsible innovation through technology innovation, real-time platform operations, standardization and public engagement [19,20].

Academic research in the context of responsible innovation has increased in recent years, considering governance and organizational institutionalization [30]. Responsible innovation brings ethics and social values into the scope of innovation consideration. It also changes the concept of innovation from the traditional cognitive paradigm that attaches importance to economic interests and ignores social interests [5,27]. However, most responsible innovation research has focused on established technology innovation or well-defined industry sectors, such as AI. As an innovative business sector, the NFT digital collection platform has not been paid attention in this body of knowledge. This is due to the fact that the NFT industry is still in its early stage without a clear industry boundary or even a standard definition.

2.2. NFT Digital Platform in China

The research setting is the NFT digital collection platform in China. This blockchain-based technology has been rapidly applied to art collections, protecting the rights and interests of creators and encrypting art collections. The core values of digital collections are mainly seen from three aspects. First is to capitalize digital content. The emergence of NFT has widened the boundaries of digital assets. Digital assets no longer only refer to digital currency, but any unique assets can be cast into digital collections [31]. Second, it relies on blockchain technology to ensure the uniqueness, authenticity and permanence of assets, and effectively solve the problem of copyright. Third, the decentralized transaction mode has improved the commercial status of content creators and reduced the commission sharing of centralized platforms.

NFT digital collections can be traded as NFTs, as long as they have value. These include digital paintings, digital photos, facial expression packs, music, short films and other types of creative content. Because of the business opportunities, NFT digital storage platforms have emerged to seize the market in China. The number of China's NFT digital collection distribution platforms increased dramatically in 2021 [32]. Considering the quality and quantity of the collections, platform flow, cultural connotation of the collections, blockchain technology level and other factors, the distribution platforms can be divided into three tiers [32]. The first-tier platforms include Jingtian, Magic Box, Lingxi Digital Collection, Hiyigou, Hongyuzhou, Dongyi Yuandian, Hongdong Digital Collection and Wanka. It is noted that these eight platforms are all linked to listed companies. The second-tier platforms are Weiyi Art, Guicnag, Quechao Culture, Blue Cat Digital, Youbanquan and IBOX. They specifically target the digital collections market. The third-tier platforms are represented by Metavision, Datang Lingjing, One NFT, Bohe, Shuangjing Museum, Saibo Xiyou Aoding, etc. Compared with the previous two categories, the third-tier platforms demonstrate lower issuance quality and quantity, less network flow and lower blockchain technology level.

In general, there are three distribution modes of the NFT digital collection platforms in China. The first is the collection mode, characterized by low level of circulation and high price. The platforms, represented by Jingtian and Metavision, enable consumers to purchase and collect digital collections through issuing digital collections with strong IP flow. Additionally, there is a unique approach known as inclusive empowerment. For

instance, Wanka platform releases the synthetic posters generated from movie IPs to the collectors. Whoever has a digital collection of the movie posters can share 1% of the fixed date box office.

The second distribution mode is the increase mode. This shows the features of large level of circulation and low unit price. For example, Jingtian and Lingxi Shuzang platforms have engaged with the general public, and benefit from the strong network flow. The digital collections can be increased through online transferring of the items after 180 days of holding. However, the second time increase can only be carried out after two years of holding the items. By limiting the circulation, the speculation risk can be reduced. This transfer mode also allocates a special number, such as a lottery number, to the digital collections. For instance, Guizang and Dongyi Yuandian platforms labeled their physical and digital collections as 111, 1234 and other special numbers. For these two platforms, all digital collections can be transferred after 15 or 180 days of holding, and collections are synthesized during the increase mode, meaning live in the metauniverse.

The third distribution mode of NFT is through the secondary market, which shows the characteristics of small level of circulation and high price. For example, IBOX has opened such a secondary market. Furthermore, the methods of blind box sales and hierarchical empowerment are seen in Blue Cat Digital, where digital collections are sold in blind boxes in descending order. Specifically, platforms can have multiple levels of digital collections, which are sold in blind boxes according to the number of circulations. The higher the level of collection, the smaller the number of circulations is, and the more value the collection is. Trading in the secondary market is possible. For example, Weiyi Art platform separates a digital collection into sub-pieces, putting them into the blind box for sale and setting the number of fragment sub-pieces. This enables the transactions in the secondary market and the integrating of the digital collections within a specified time period.

Recently, the popularity of the platform decreased slightly in China along with potential problems [33]. Many WeChat Apps of NFT Databank platforms have been suspended due to the suspicion of bypassing, evading or confronting audit supervision. Large platforms, such as Jingtian and Huanhe, do not support secondary trading. However, the secondary market still exists in China. As the pricing of digital collections does not have a strict standard, there is speculation risk. Besides, young people want to invest in digital collections even though the collections cannot be resold. Thus, they can be heavily in debt.

2.3. Research Gaps Identification

Literature review indicates that responsible innovation research is a growing body of literature in recent years [22]. The concept has been explored in digital technologies such as AI and sharing economy such as the shared bike sector [19,20]. However, its linkages with NFT, the blockchain and platform-based new business, is not clear yet. With technology advancement and user engagement, NFTs are blooming alongside potential risks relating to ethics and social responsibility [33]. In the research setting of the NFT industry in China, the digital collection platform mainly faces three risks. The first is operational risk, which refers to the disclosure of data and privacy due to improper operations by users. The second is technology-related risk. Behind NFTs is a smart contract, in which all operations are executed through lines of code. If these codes are not perfect, it is easy for hackers to exploit and attack the system. In addition, some phishing projects use fraudulent activities to induce users to authorize a smart contract, and hackers can steal authorized assets in the user's wallet through the smart contract. The third is moral hazard. Some projects use NFT as a gimmick to defraud users of their digital assets. Therefore, how to innovate responsibly on the NFT platform has become important, that is, to undertake the social responsibility of technological innovation while ensuring the sustainable development of companies and users. Accordingly, responsible innovation provides an appropriate theory lens to explore this issue.

3. Research Methodology

Figure 1 shows the conceptual framework of this study. It aims to answer the question: how can China’s NFT digital collection platform achieve sustainable development in the context of responsible innovation? It introduces the theory of responsible innovation to this type of business platform for in-depth analysis.

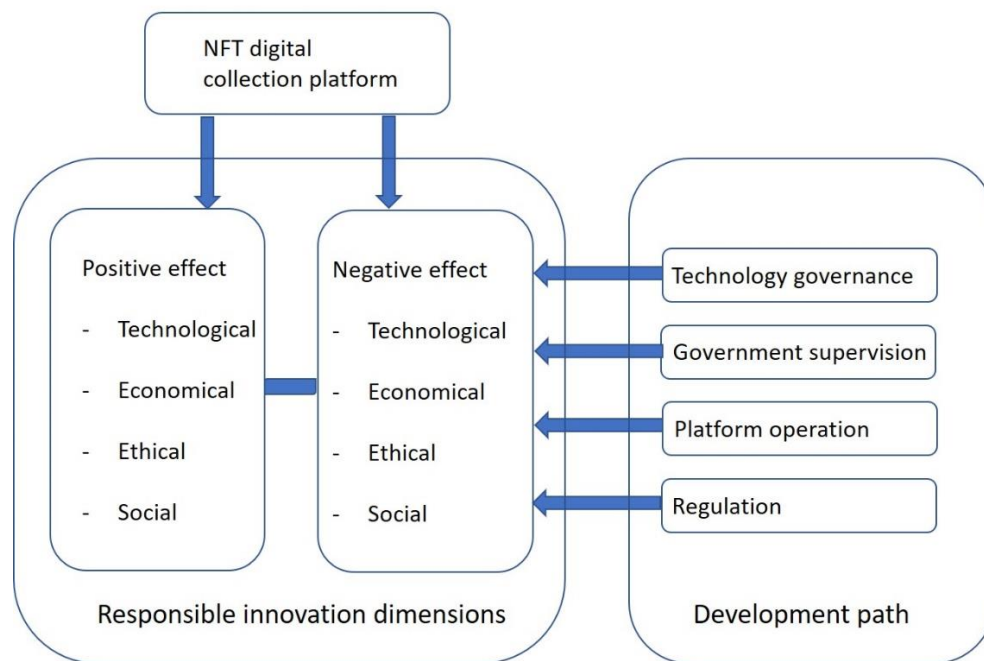


Figure 1. Research framework.

Specifically, the research concerns four dimensions of responsible innovation, namely, technological dimension, economical dimension, ethical dimension and social dimension applied, which is adapted from the framework of Mei et al. [4] and Mei and Chen [5]. In addition, technological dimension considers the meaning of anticipation [7] and technology assessment [11,12]. Economical dimension also concerns responsiveness to knowledge [7], and thus identifying new market potentials. Ethical dimension also includes the moral factors [13]. Social dimension is consistent with public engagement [9], openness [15], inclusion [7] and bottom-up social structure [22]. To achieve the responsible innovation of NFTs, the developed paths can rely on technology governance [7,19], government supervision [20,34], platform operation [35] as well as regulation [7,20–22,36].

To explore this on-going issue, which is under-explored, an interpretive approach is adopted. We engage with key individuals, namely, artists who are both content providers and users for the NFT platform, collectors who purchase and transfer art collections and art agencies through semi-structured interviews (see Table 1), to understand the driving forces, advantages, challenges and trends of the NFT industry in China. Each interview lasts around 2–3 h. The research unit is individuals and their interaction with the NFT collection platform. Sample questions during the interview are: What motivated you to engage with the NFT platform? What happened based on your experience? What worked so far? What are the challenges and risks? What are the driving forces for the NFT industry growth? Why do the platform companies join the NFT business? How can the NFT platform be more sustainable? Open questions are also asked tailored to the role of each individual.

Table 1. Overview of semi-structured interview.

Interviewee/Location	Interviewee Occupation	Date of Interview	Focus of Interview
Interviewee One/Hangzhou city	Professional calligraphy and painter; Art collector	October 2021; 2 h	Online trading of calligraphy and painting
Interviewee Two/Nanjing City	Professional cultural product intermediary	May 2022, 3 h	Online education and trading of cultural collections
Interviewee Three/Jinan City	Cultural relics enthusiasts and collector	August 2022; 2 h	Cultural relics trading on online platforms
Interviewee Four/Shanghai City	Cultural relics collector	September 2022, 3 h	Cultural relics trading on online platforms

In addition, we collected secondary data from archives and reports provided by organizations (e.g., research institutes, consultancy companies) to ensure data triangulation and robustness [37]. A summary of the secondary data is shown in Table 2, which highlights the source and content.

Table 2. Overview of secondary data/report.

Source of the Data	Name/Content	Publication Year	Amount
π Tuoluo Research, π Tuoluo Tech	<i>The Key of Metauniverse Value: Report on the Development and Application of Digital Collections</i> [38].	March 2022	35 pages
Alibaba New Service Research Center; Alibaba Local Life to Housework Center Interactive Game Team; Intelligent Business Research Team of Zhejiang University of Finance and Economics; Zhejiang Federation of Service Industry	<i>Blockchain Technology and Catering Digital Collection Development Trend Report</i> [39].	April 2022	38 PPT slides
iResearch Inc.	<i>Research Report on China’s Digital Collection Industry</i> [40].	September 2022	58 PPT slides
Key Laboratory of Science, Technology and Standards of the State Press and Publication Administration; Blockchain Copyright Application Centre	<i>Digital Collection Application Reference</i> [41].	July 2022	31 pages
Head Leo	<i>China NFT Platform Research Report</i> [42].	January 2022	40 PPT slides
Hang Hang Cha Research Center	<i>2021 China NFT Industry Research Report: NFT Has Become a New Favorite in the Currency Circle. Is It a Wind Gap or a Smokescreen?</i> [43].	2021	28 PPT slides
Shanghai Smart City Development Institute; Shanghai Pudong New Industry Research Technology Industry Research Center	<i>2022 White Paper on Industrial Technology and Innovative Application of the Metauniverse</i> [44].	2022	35 PPT slides
Deloitte	<i>Metauniverse Overview—Vision, Technology and Response</i> [45].	2022	50 pages
Eastmoney Securities	<i>Comparative Study of Digital Economy and Metauniverse between China and the United States</i> [46].	April 2022	27 pages
China Electronic Information Industry Development Research Institute; Jiangsu Institute of Communication	<i>White Paper on the Ecology of the Metauniverse Industrial Chain</i> [47].	May 2022	101 pages
National Key Research Office of Media Integration and Communication, Communication University of China New Media Research Institute; Sina News; CCTV Smart Media Institute	<i>2022 Metauniverse Research Report: Multi Vision</i> [48].	January 2022	118 PPT slides
New Media Research Center of Tsinghua University	<i>2020–2021 Metauniverse Development Research Report</i> [49].	September 2021	126 PPT slides

Data then go through thematic analysis [50] and active categorization [51]. The detailed steps include: (1) transcripts are open coded independently by each author; (2) initial codes are generated by all authors; (3) categorization with key themes alongside the responsible innovation dimensions; (4) continuously analyzing until theoretical saturation; and (5) finalization of the themes.

4. Findings

Findings are summarized as in Table 3, addressing the positive and negative effects of the NFT platform against the responsible innovation framework. Details are to be elaborated alongside the responsive innovation framework of technological, economical, ethical and social dimensions [4,5].

Table 3. Summary of the findings.

Responsible Innovation Dimensions	Positive Effect	Negative Effect
Technological dimension	<ul style="list-style-type: none"> - Innovative application of blockchain - Based on the smart contract of Ethereum, the user’s ownership of specific assets is marked through the blockchain 	<ul style="list-style-type: none"> - The smart contract behind NFT is based on code execution. The code is incomplete, and the project is vulnerable to attack - Potential risks of phishing websites.
Economical dimension	<ul style="list-style-type: none"> - Sales of digital collections - NFT owners obtain the required funds through loans and enter the industry - NFT digital collections are traded in the secondary market - NFT derivative development 	<ul style="list-style-type: none"> - The speculation of speculators makes NFT have a premium - The price fluctuation of virtual currency affects the value of NFT art collections
Ethical dimension	<ul style="list-style-type: none"> - NFT attracts the attention of the political, business and academic circles to the emerging field of digital collections, and trigger thinking - NFT platform cultivate people’s awareness of copyright. 	<ul style="list-style-type: none"> - Trust crisis. Infringement and piracy of NFT between different platforms often make illegal profits - Physical art collections are impacted negatively
Social dimension	<ul style="list-style-type: none"> - Affixing anti-counterfeiting codes to original works is conducive to protecting intellectual property rights - Participants can collect digital artworks according to their preferences 	<ul style="list-style-type: none"> - At present, the rules and regulations related to NFT industry in China have not yet been introduced - The society is prone to blindly follow the trend of NFT - The social image can be damaged due to the negative content of NFT

4.1. Positive Factors under the Responsible Innovation Framework

4.1.1. Technological Dimensions

The adoption of NFT technology on the digital collection platform is an innovative activity. The industry pattern is converging, with the industrial chain and ecosystem rapidly taking shape [38,48]. The underlying protocol standard of NFT digital collection technology provides a basis for the free transfer or transaction of private property on the blockchain, which demonstrates significant technology and process innovation. According to the interviews,

“The NFT digital collections are really novel. I think its popularity is mainly due to the innovation and development of technology. The emergence of the metaverse has created an opportunity for the popularity of NFT digital collections. Blockchain technology encrypts digital collections. Like our calligraphy and

painting works, the blockchain realizes authentic digital distribution, purchase, collection and use based on the protection of its digital copyright through the unique digital certificate generated. Depending on blockchain technology, each digital collection has a unique block number. After the artwork or product is encrypted digitally, it will have a unique digital qualification certificate, which will be stored on the chain and cannot be forged or copied. Digital collections are diversified, as if everything can be digital collections.”

—Interviewee One

Besides, NFT is based on the Ethereum smart contract to determine the ownership of the creators’ works. Specifically, NFT is a digital asset token that uses blockchain smart contract technology. It can mark a specific item and is indivisible. As a virtual commodity, NFT digital collections are scarce, and their production requires material input and scarcity is set artificially. Furthermore, NFT technology marks digital files through blockchain technology to distinguish the relationship between owners and users.

Moreover, the NFT application scenario is broad, which will accelerate the integration of traditional cultural fields in the short term [38]. In the long term, this technology can build a metaverse innovation ecosystem [38].

4.1.2. Economical Dimension

The NFT digital collection is an emerging industry with potential economic benefits, which is reflected in the business model of the platform. The NFT digital collection platform mainly include sales, loans, NFT funds and derivatives development. Due to the rapid popularity of NFT digital collections, the new business model attracts major enterprise platforms to join the industry, occupy a market and expand the platform. Thus, there is a trend to integrate digital collections with the real economy, which can accelerate the upgrading of industrial structure and consumption structure. As interviews indicate,

“On the one hand, digital collections have artistic value and brand value. After being combined with NFT, these artistic values are attached to the products to meet the diverse collection needs of consumers. On the other hand, digital collections also have social attributes. Many niche cultures are gathered through the Internet, such as anime culture. Through digital collections, topics can be formed among these niche culture lovers, so as to achieve the purpose of social interaction . . . As a product of the digital economy, digital collections have great economic significance.”

—Interviewee Two

Furthermore, the blooming of NFT can improve the utilization rate of platform resources, attract talents for employment and create digital productivity.

In the future, traditional consumer enterprises can also enter the NFT market, while blockchain games and the metaverse will drive the expansion of the NFT industry [42]. Consequently, new business models [45] and innovation ecosystems [45,47] can be further developed.

4.1.3. Ethical Dimension

The NFT digital collection is a new phenomenon, which has drawn the attention of policy makers, business and academia to interact actively. Meanwhile, to a certain extent, it has cultivated the public’s awareness of copyright. As NFT digital collections are marked by the blockchain, users can have the ownership. This is shown during the interviews,

“As a Chinese calligraphy enthusiast, I also pay close attention to digital calligraphy works. In the past, I did not know that digital works also have copyright. Through NFT, I learned that digital works also have copyright . . . Now, my academic friends also pay attention to the functions of NFT and the new business model.”

—Interviewee Three

4.1.4. Social Dimension

NFT digital collections promote interaction among different social groups. It is built upon incentives and joint effects from creators and users to protect the intellectual property rights of art works. As a result, artists are more willing to participate in the creation of works. According to the interviews,

“Digital collections are highly social, and people from all backgrounds want to participate. I remember last December, Visual China launched the visual art digital collection platform Metavision and donated the proceeds of the first digital collection ‘I want to go to school’ to Project Hope (a public service project).”

—Interviewee Two

“Many libraries now introduce digital works, provide public cultural services, promote the reading of the whole people, improve the quality of civilization, and inherit the excellent traditional Chinese culture. For example, Shandong Provincial Books will launch the digital collection of ‘The Complete Map of the Yellow River in Shandong’, explore the innovation mode of digital literature, deeply tap the collection resources, and create a series of digital cultural creative products with more diversified, cultural connotation and collection value . . . digital collections have a positive impact on social education.”

—Interviewee Three

Moreover, due to its high attention, participants are likely to collect digital artworks according to their own preferences. They then collect, transfer or sell the items.

4.2. Negative Factors under the Responsible Innovation Framework

4.2.1. Technological Dimension

The development of NFT relies highly on the completeness of the blockchain technology, which has potential risk [38]. Furthermore, the NFT operations are executed through lines of code. If these codes are not perfect, they can easily be exploited by hackers to attack the project. Thus, there is a security concern regarding the technology [41].

In addition, some phishing projects will use fraudulent activities to induce users to authorize a smart contract, and hackers will steal all authorized assets in the user’s wallet through the smart contract. Such technological risk is pointed out according to our interviews,

“I’m worried about the security of the NFT platform and about hackers stealing assets from my wallet. I won’t use NFT to trade.”

—Interviewee Four

4.2.2. Economical Dimension

There are several negative effects of NFTs on data collection. First, the behavior of speculators results in NFTs having a premium. The traditional collection industry is very similar to the NFT industry. In the small art circle that was initially cultivated to collect NFT artworks only for hobbies and values, the more loyal the circle is, the easier it is to attract outsiders to speculate on collections. As time goes on, people who have entered the market increase their pursuit of NFT investment desire. When the number of people involved in the business becomes larger, more premium art works can appear. The smokescreen and speculative side effects in the NFT market will gradually expand.

Second, the price fluctuation of virtual currency affects the value of NFT artworks [43]. On the trading platform, NFT artwork is priced in cryptocurrency. Due to policy supervision, economic situation [46] and other reasons, the price of cryptocurrency fluctuates greatly. Meanwhile, the price of digital collections experiences similar drastic fluctuations. The price of physical works can be changed at will because they are made into NFTs, which will disrupt the existing pricing system. Thus, it is difficult to ensure the healthy and sustainable development of the market. According to our interviews,

“At present, there are smokescreen and speculation in the NFT market, which affect my use of the platform; In addition, the economic situation is not good due to local policy supervision and epidemic situation, the price of cryptocurrency fluctuates greatly, and the price of digital collections fluctuates greatly, which will affect my trading on the platform”

—Interviewee Three

Other factors are seen in terms of capital manipulation risk, general economic risk and monopoly risk [49].

4.2.3. Ethical Dimension

There are ethical constraints in the NFT business [49]. Infringement and piracy of NFTs between different platforms occur from time to time. Although there is a competitive relationship between platforms, malicious competition means should be eliminated. It is noted that the physical art collections have been impacted, and the popularity of digital collections has distracted the public attention. The risk relating to ethics is specifically concerned according to the interviews,

“The platform should advocate against secondary transactions and speculation, and improve access standards to become the consensus of high-quality development of the industry . . . As the public continues to deepen their understanding of digital collections and the technology continues to improve, the digital collection market will develop more normatively. Both artists and collectors can seize the opportunity of digital collections and create more meaningful value.”

—Interviewee Two

“While NFT is developing rapidly in China, we also see risks. At the moment, when the scale of the market continues to expand, there is inevitably concern about financial risks. I think the most important thing is that the state and enterprises should take measures to consolidate the market order . . . in order to prevent financial risks, protect the legitimate rights and interests of consumers, and maintain the healthy ecology of the industry, major policies need to curb the tendency of financial securitization of digital collections and strictly prevent the risks of illegal financial activities.”

—Interviewee Four

4.2.4. Social Dimension

At present, rules and regulations in China related to the NFT industry have not yet been introduced. Hence, it is easy for society to blindly follow the trend of NFT. Users can excessively pursue a fresh sense of experience, without noticing that collections may lose value due to timeliness. Moreover, some platform organizations do not have a complete understanding of NFTs and misjudge the market trend. Negative opinions towards NFTs appear because of the misunderstanding from individuals and companies involved.

It is noted that relevant policies can ensure the healthy, orderly and benign development of the industry [40]. According to the current national policies, laws and regulations of China, the safest way to establish the NFT trading market is through licensed operation. Meanwhile, it is also possible to trade by pawning [42]. As the interviews reveal,

“The rules and regulations related to NFT industry in China have not yet been introduced, and the development of NFT is in chaos, affecting the development of the platform.”

—Interviewee Two

The opening of the secondary market for digital collections is a sign of the real opening of the market. This needs to occur under a strong financial regulatory mechanism [40]. Furthermore, there is need for a regulatory governance system [44].

5. Discussion and Conclusions

5.1. Discussion: The Development Path of China's NFT Digital Collection Platform

A precondition for the sustainable development of the NFT digital collection platform is to build NFTs into digital assets with collection and other values. However, if more participants turn NFT into a new tool for capital speculation or money laundering, the industry will finally become a smokescreen. Based on the analysis of the NFT digital collection platform alongside the responsible innovation dimensions, we propose the following four development paths for NFT.

The first path is technology governance to promote platform development. The blockchain technology adopted by the digital collection platform can be divided into public chain, private chain and alliance chain. Each platform should choose endorsed blockchain technology according to its own characteristics. For example, Alibaba's Jingtian is the Ant Alliance chain, and Tencent's magic core is the Zhixin chain. The code of the smart contract should be improved, and the program execution process should prevent hackers from invading. Although smart contracts are embedded in NFT art works by relying on code rules and cannot be stopped or modified during operation, this situation is not absolute and not completely intelligent. This is because everyone may apply for NFT encryption for a digital work, which can lead to fake creators. Platforms can set a security mechanism to strengthen technical governance, which can immediately identify phishing websites and prevent users from authorizing.

Secondly, government supervision can help to create market order. This can help define the legal nature of NFT. As a token, NFT is essentially a virtual digital asset. Furthermore, NFT is a document of right rather than a right in legal nature. NFT is also different from its digital carrier. The rules and regulations on China's NFT industry have not yet been issued, and many details of rules and regulations are not clear. Because there is no unified pricing standard, this has caused the holder to set prices at will or even speculate on prices, which seriously deviates from the actual value. At present, the stage of NFT art trading is mainly supported by the online celebrity economy and fans' enthusiasm. Once the online celebrity has passed, the digital products made by high price speculation will inevitably become a collapsed premium commodity. In addition, there is speculation in the NFT market, alongside increasing worries about whether NFT will become a new money laundering channel. In January 2022, the China Technology Market Association, together with several industry, university and research institutions, launched the Request for Comments on the NET Platform and Product Evaluation. In July 2022, the Digital Collection Application Reference compiled by the Blockchain Copyright Application Center of the National Key Laboratory of Science and Technology and Standards was released. Therefore, government supervision is essential for the sustainable development of the major digital collection platforms, and for creating a good social order.

Thirdly, there is a need to cultivate the platform to improve operation. NFT data collection platforms need to consider social responsibility to form a conscientious corporate culture. Most NFT transactions rely on the platform, from the creation of NFTs, to linking them to the value chain, to the transaction. The platform generally charges fees, transaction commissions, etc. In this new copyright circulation mode, the platform should determine the copyright owner of NFT works to ensure the originality of the works.

Fourthly, a regulatory system is required for platform compliance. Platforms can refine their own management rules. This not only refers to the NFT data collection platforms, but also platforms with WeChat and Alipay as carriers. Platforms need to clarify the trading rules of digital collections set by the Chinese government, requiring real name authentication of creators and buyers, and clarifying the platform for information encryption. Thus, if a data collection platform violates the rules of the carrier platform, it can be stopped from operating. For example, there was a digital collection service provided by the Weiyi Art platform, which is linked to a service category that has not been opened. Thus, due to violating the rules of WeChat, the service was terminated.

5.2. Discussion: NFT, Responsive Innovation and Open Innovation

NFT happens in the paradigm of open innovation [52], which is currently evolving with features of macro-level dynamics [53], micro-level dynamics [54], servitization [36] and sustainability-orientation [55]. NFT, as an emerging sector, follows the digital platform business model and the adoption of blockchain. Specifically, it can be regarded a context-driven innovation [56], referred to as the process of applying the existing technology to a specific scenario to create greater value. This type of innovation is increasingly linked with sustainability and corporate social responsibility [36,56,57]. The innovation of NFT also shows a process of breaking through the existing technical bottlenecks, creating new technologies, new products, new channels, new business models and even new markets and fields. Thus, the understanding of the NFT platform broadens the knowledge scope of open innovation.

Moreover, the NFT platform is a new form of blockchain technology application. In general, the platform-based business model can expand the open innovation activities to emerging new sectors driven by digital technologies [35,58]. As blockchain has been rapidly applied to art collections, NFT can protect the rights of creators and encrypting art collections. It links open innovation with intellectual property issues in the field of art collection.

NFT involves interaction among artwork suppliers and customers, which is consistent with open innovation dynamics [53]. Specifically, artists, collectors, brokers and connoisseurs have formed an open innovation ecosystem on the NFT platform. Authors can provide works or recreate them according to user needs. Artistic works achieve commercial value on the platform. In this dynamic environment with features of flexibility, adaptability and openness [15], it is important to protect the original works of the artists, which is the open innovation outcomes, as well as guide innovative actors to perform in an ethical and sustainable way [7,20]. Thus, the concept of responsive innovation provides a new dimension for the open innovation paradigm in terms of the governance of innovation [8,20–22]. A top-down institution combined with bottom-up wider society participation [8,22] may facilitate the dynamic changes of open innovation in the emerging digital platform-based business models.

5.3. Conclusions, Implication and Future Research

The combination of NFT with paintings, sounds, games, videos and other creative contents is an innovation to protect the copyright of authors. It digitizes physical works with unique characteristics. At present, the NFT industry is blooming in China in the form of digital collections. This has attracted increasingly more artists, collectors and enterprises to join. However, due to the potential risks from technology, operations and ethics aspects, the NFT digital collection platform is facing challenges and growth limitations. This study has adopted the responsible innovation theory framework, analyzing the positive and negative effects of China's NFT digital collections alongside technological, economical, ethical and social dimensions. By specifically addressing the negative effect, the paper has proposed the development paths of China's NFT digital platform, to achieve sustainability.

With the focus on China's NFT business in the digital art collection sector, the study has brought new content and scenarios to the platform-based open innovation. It is noted that NFT is built on blockchain technology, which originally comes from Western countries and recently gained popularity in China. The investigation of responsible innovation dimensions can widen the understanding of the emerging challenges, as well as the evolving business models of NFT globally. Issues such as how to tackle technology security related risk and macro-economic downside risk can be generalized outside China. Nevertheless, differences exist in terms of technology infrastructure and regulations. For example, China's digital penetration rate is higher than that of the USA [46]. The USA Internet giants focus on VR, cloud computing and other infrastructures, while Chinese companies have launched NFT [47]. Whilst there are matured intellectual property in developed Western countries, the regulation system to protect creative works via the NFT platform is still developing

in China. Thus, the priorities of governance, especially regarding the role of soft-law and hard-law regulation, can be different [20]. Nevertheless, a global collaboration can promote a healthy sustainable development of the whole industry [8].

There are some limitations of the study. It mainly relies on primary data by interviewing artists, users and agencies who engage with the NFT platform at individual level. More perspectives are needed from other actors of the platform, including platform operation companies and regulators. Thus, future research can explore details of the governance of innovation alongside the lifecycle of the NFT business. Comparative studies among different countries can also identify the interaction between NFT and macro-economic factors. Moreover, the NFT digital collection is an emerging new industry, and a clear definition needs to be developed through conceptualization and empirical studies.

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