THE FUTURE OF NON-FUNGIBLE TOKENS' MARKET APPLICATIONS: AN ANALYSIS THROUGH THE TECHNOLOGICAL INNOVATION SYSTEM LIFE CYCLE APPROACH

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Abstract: Previous research on blockchain technology has begun to explore the case of NFTs, which represents one of the most promising blockchain applications for businesses. This article investigates the journey of 21 actors evolving within the NFT innovation system. We demonstrate through the "selective phase" that despite initial trends around NFTs, notably within the creative industries, this technology is still at an early stage of development and adoption, and a selection process is ongoing among stakeholders to identify valuable market applications. To address this topic, we build upon the Technological Innovation System life cycle approach, which aims to explain the emergence and development of new technologies. This article provides entrepreneurs, managers and investors with recommendations regarding the NFT technological valorization process.

Abstract : Les recherches antérieures sur la technologie blockchain ont commencé à explorer le cas des NFT, qui constituent l'une des applications de la blockchain les plus prometteuses pour les entreprises. Cet article analyse le parcours de 21 acteurs évoluant au sein du système d'innovation des NFT. Nous montrons, à travers la « phase de sélection », que malgré les premières dynamiques autour des NFT, notamment au sein des industries créatives, cette technologie en est encore à un stade précoce de développement et d'adoption, et qu'un processus de sélection est en cours entre les parties prenantes afin d'identifier des applications de marché. Pour traiter cette question, nous nous appuyons sur l'approche du cycle de vie des systèmes d'innovation technologique, qui vise à expliquer l'émergence et le développement de nouvelles technologies. Cet article propose aux entrepreneurs, managers et investisseurs des recommandations concernant le processus de valorisation de la technologie NFT.

Keywords: NFT; Blockchain; Emerging technologies; Technological innovation system; Life cycle

Introduction

In 2021, Beeple's digital artwork was sold for $69 million (Wilson et al., 2022). This sale was surprising at the time because it mobilized NFT technology (i.e., Non-Fungible Tokens), a technology little known to the general public. Today, we can say that this technology stemming from the blockchain is becoming common knowledge. NFTs mobilize blockchain technology to enable the digitization of assets and ownership chains for both tangible and intangible assets (Wilson et al., 2022). NFTs uphold transparency, encryption, and embody distinct types of resources. Each NFT is non-interchangeable or non-fungible, indicating that it cannot be replaced because it is unique (Malik et al., 2022). In this context, NFTs serve as an innovative form of ownership (Belk et al., 2022).

However, there are emerging concerns regarding the future of NFT technology, notably its market applications and impact (Chalmers et al., 2022). For instance, since 2022, there has been a downturn for NFTs in the creative industries. As such, entrepreneurs are in the process of redefining the utilization of this technology (Financial Times, 2021). Consequently, it becomes critical to explore new applications of NFT technology (Chalmers et al., 2022; Malik et al., 2022), its impact over time, and the strategies for its sustainability (Holm and Goduscheit, 2020). To explore the temporality of NFT's technological application and impact, we decided to use the Technology Innovation System (TIS) life cycle approach introduced by Markard (2020). The TIS life cycle is a recent approach that aims to clarify the emergence and development of new technologies by examining the different phases of technological evolution (Bergek and Jacobsson, 2003). Throughout this research, we aim to contribute to two fields of research: one focused on blockchain and NFT's application and impact, and the other on the TIS life cycle approach. We formulated the following research question: **How is NFT, as a new emerging technology, evolving along its TIS?**

To address this research question, we conducted empirical studies by carrying out a case study on the main French NFT ecosystem: the NFT Factory, a key institutional hub located in Paris. We conducted 21 semi-structured interviews with diverse actors involved in the NFT TIS surrounding the NFT Factory, aiming to understand how this technology is emerging and evolving within this ecosystem. We applied an extensive multilevel qualitative study using an abductive method. Our goal was to explore the TIS life cycle of NFT technology through its *formative, growth,* and *mature phases* in line with Markard (2020)'s model. Our research contributes to the field of NFT technology and the TIS life cycle approach by revealing the existence of the "selective phase" which has not been highlighted within Markard (2020)'s model. The selective phase is a consolidation phase, involving the elimination of "weak" actors and the retention of the "strong" ones. This process, taking place after a period of speculation and abundant investment, is critical to establish the foundations for sustainable growth. We provide guidance to entrepreneurs and managers on the potential of NFTs and encourage them to focus on use-cases rather than technological hype.

Literature review

Blockchain technology, Non-fungible Tokens and value proposition. Blockchain technology was initially introduced through Bitcoin, a digital currency that combined cryptology and an open distributed ledger (Xu et al., 2019). Blockchain technology can be defined as *"an open, distributed ledger that efficiently records transactions between two parties in a verifiable and permanent manner"* (Iansiti and Lakhani, 2017, p.4). Over the years, blockchain technology has evolved

beyond Bitcoin, and today, numerous sectors have become involved with this innovative technology (Frizzo-Barker et al., 2020). In accordance with Schlecht et al. (2021), blockchain technology has the potential to significantly impact a firm's value creation and value capture mechanisms, enabling the development of new business models across various industrial sectors.

In our paper, we are referring to a specific type of blockchain technology, the Non-Fungible Tokens (NFTs). NFTs take blockchain a step further by advancing the digitalization of assets and chains of ownership, encompassing both physical and intangible assets (Wilson et al., 2022). NFTs maintain transparency, encryption, and represent unique forms of resources. Each NFT is non-interchangeable or non-fungible, meaning it cannot be substituted with another NFT (Malik et al., 2022). In this sense, NFTs represent novel forms of ownership (Belk et al., 2022). NFTs may be considered as a disruptive innovation as it was previously shunned by consumers but then rapidly invaded the creative industry's market, notably after the unprecedented sale of Beeple's NFT artwork for 69 million USD in 2021 (Wilson et al., 2022). A similar phenomenon can be expected for the application of NFTs in different industries.

Nevertheless, there are some concerns regarding the market applications and impacts of NFT technology (Chalmers et al., 2022). A bear market in NFT technology is observable, and the market segment related to artistic NFTs is losing momentum. Thus, it seems important to question the NFT technological application (Chalmers et al., 2022; Malik et al., 2022), the impact of this technology over time, and how it can be sustained (Holm and Goduscheit, 2020). So far, no empirical studies have explored the nature of these new entrepreneurial ventures (Chalmers et al., 2022). Therefore, gaining a deeper understanding of this phenomenon could provide clarity on the potential applications of NFTs, support projects embracing NFT technology, and guide established companies in adopting these disruptive technologies. To study this phenomenon, the TIS life cycle approach was privileged as a relevant framework to study the different phases of evolution of a technology.

The TIS life cycle approach to explore the NFT technological application. Markard (2020) was the first to introduce the TIS life cycle approach, with four distinct TIS phases: *the formative phase, the growth phase, the mature phase, and the decline phase.* The formative phase **(1)** is characterized by a low number of actors, with nearly non-existent sales. The network primarily focuses on research and development, experimentation, and prototyping. The emerging Technological Innovation System (TIS) is characterized by the presence of competing ideas and a diverse array of technology designs. Concerning the growth phase **(2)**, it is defined by a high-growth rate and a high entry level. The volume of sales is higher than in the formative phase, although still below the market potential. Along this phase, there is a critical mass of actors in different roles with an increasing level of specialization. Intense competition prevails, leading to potential conflicts over the selection of standards to be adopted. On the subject of the mature phase **(3)**, it is characterized by robust sales but modest growth rates. This phase exhibits a remarkably stable TIS with minimal instances of firm entries and exits. The actor base is distinguished by specialized entities. The mature phase witnesses a high level of structuration and institutional stability. Products and applications are well-defined, and the technology is not only widely recognized but also taken for granted. Finally, regarding the decline phase **(4)**, it is characterized by a decline in sales, leading to an increasing number of participants exiting the TIS. Intermediaries experience a diminishing significance, established value-chains disintegrate, and networks dissolve. TIS actors struggle with pessimistic outlooks regarding the technology's future, contributing to the destabilization of technology-based institutional structures.

In-depth interviews

To underpin this study, we conducted 21 semi-structured interviews with different actors ranging from artists and entrepreneurs to consultants and investors. We especially focus on the NFT Factory, an active NFT ecosystem located in Paris. All interviews were meticulously recorded, resulting in 1065 minutes of audio and 230 pages of transcriptions. Interviews extended from 30 minutes to 1 hour. We first inquired about the actors' background and initiation to NFT technology. Subsequently, we delved into the evolution of their NFT related activities (*e.g.,* integration of NFT technology in their business model; investment strategy within the NFT ecosystem; etc.). Additional questions focused on their perception of the NFT market and changes in the ecosystem.

Results[1]

The selective stage or "the purge". As detailed previously, this selective stage was not identified in past research on the TIS Life Cycle. Yet, this phase emerged clearly as a crucial and perhaps most challenging step. Besides, the actors we interviewed explained how this selective stage is the actual situation since the beginning of the current bear market in 2022. This phase is characterized by disillusion and a large withdrawal from a significant number of entrepreneurs, investors and companies. The term "winter market" or "bear market" came back frequently in our interviews, illustrating the current hardship for the NFT ecosystem and the need for its community to survive this phase.

"The hype was almost too big. A lot of people invested, thought it was an investment bubble. Most came back, I think 9 out of 10 people lost money by investing in the NFT. So yes, there was a craze followed by mistrust." (Interviewee 19).

"There are very few companies that, at the moment, would make an NFT project by fomo (fear of missing out). It's more the opposite at the moment to say 'do I really want to do an NFT project?' because it's no more top of mind. Before, yes, clearly, there were a lot of companies that did sloppy projects just to do something, because they said, 'Oh, I'm going to miss this financial windfall" (Interviewee 15).

Also, many of our respondents have (again) compared this phase with the collapse of the dot-com bubble back in 2000, which gives faith in the future of NFT technology and its utility.

"Like during the dot-com bubble, there was a huge hype, everyone believed in it, everyone thought it would be adopted ultra-fast. As a result, huge investments were made." (Interviewee 13).

"Well it's like the Internet bubble, that is to say that there has been speculation, there are plenty of startups that have collapsed… but internet has not disappeared… so it's a little bit the same, it's a big "spring cleaning", it sorts the projects out, and it will go back up for sure… but right now it's kind of the winter" (Interviewee 20).

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[1] As the short paper is limited to 5 pages, we decided to focus only on the selective phase, which represents our main theoretical contribution. The extended paper includes a phase-by-phase analysis.

Nevertheless, this is a necessary step for the widespread of NFT Technology. The loss of interest for NFTs in the creative industries is leading actors to conceive new applications in different sectors and to innovate. Also, this stage, qualified as a "purge" for some, is necessary to sort the good (or serious) actors with valuable projects based on practical and impactful applications, from the bad (opportunistic) ones. As a result, the market is much less saturated and the actors who remain invested in the NFT ecosystem are gaining a competitive advantage over the future actors who will enter or re-enter the market when NFT technology regains momentum. Current actors are shifting their focus from the technology itself to the technology's capacity to answer practical needs for consumers and businesses. Therefore, such actors are considering the technology's utility and market impact. Many view this stage as a positive phenomenon because it is bringing back confidence and quality in the application of NFT technology.

"Indeed, there is a big purge, and today we have a market that, even if it is low, is very healthy, because all the projects, which had nothing to offer, did not survive, so it does us a lot of good, so even if it made us a big fear, we say to ourselves that this adds confidence, because the people who are still there, even though the market is not doing very well, are people who are there for the market, and not to make money on people's back" (Interviewee 10).

"Why has it gone down all over Web3? Because there are always a lot of hacks and scams. So our argument to say that we are serious people, in any case that the project is serious, is that we meet a need. There is a need for trust, we respond to this need" (Interviewee 17)

Therefore, along those interviews we perceived this phase as necessary for the NFT technology to find its market application, as the resources dedicated to NFT related projects are scarce, and the competition is becoming high between actors, notably to raise funds. Thus, entrepreneurs need to work on their value proposition through the NFT technology, gather necessary human and financial resources and build their reputation (notably through the recognition of expertise) if they want to thrive in the market. In that context, the selective phase is marking a clear rupture along the previous TIS life cycle model, as it clearly contests the commonly accepted straightforward path regarding innovation and market application. We highlight the differences between the old model by Markard (2020) and our new model in the appendix section (see figure 1).

Theoretical contribution

First, the study contributes to understanding blockchain technology's emergence, particularly focusing on Non-Fungible Tokens (NFTs), an area lacking empirical investigation prior to this research (Chalmers et al., 2022; Holm and Goduscheit, 2020). We argue that for blockchain and NFT technology to achieve their full market potential, they must undergo various development phases (Schlecht et al., 2021). The study shows that while NFTs initially gained attention in the art sector, actors deeply involved are exploring new market applications (*e.g.,* communication; cyber-security; supply chain; education; etc.), indicating broader potential beyond an industry-specific context (Chalmers et al., 2022; Malik et al., 2022).

Second, we enrich Markard (2020)'s TIS life cycle model through the "selective phase" that is identified in the current research which contradicts Markard (2020)'s concept of straightforward technological development. We argue that the selective phase is a necessary stage for the market to consolidate by eliminating "weak" actors and retaining the "strong" ones. Through this selection, which comes as an answer to the previous phase of speculation and abundant investment, we argue

that technology can find its path for sustainable growth. We believe this phenomenon could apply to other technologies, as many of our respondents' testimonies draw parallels with the emergence of the internet. This "selective phase" echoes the "disillusionment phase" detailed in the hype cycle model from Gartner.inc's consultancy firm which explains how the loss of interest in an innovation (i.e., reduced hype) leads actors to develop second generation products and services. We propose that the selective phase is required for a disruptive technology to find its path for sustainable growth.

Managerial contribution

We recommend that managers consider incorporating NFT technology into their company's business model, starting by hiring an expert in blockchain technology. Failing to recognize the upcoming impact of this technology may pose a threat to business survival (Wilson et al., 2022). Also, we advise actors to shift their attention from the hype around NFT technology and focus on NFT's use cases instead. Our study reveals that the hype can be deceptive, as it may not accurately represent the future value and applications of the technology. Also, we recommend for investors to be mindful of the "selective phase" when assessing high potential projects. It would be prudent not to invest in technologically driven projects during the growth phase but rather during the selective phase when stronger actors are establishing a foothold, and the capital price is low.

Limitations and avenues for future research

A more robust alignment with the TIS approach could have been achieved by interviewing different institutional actors (*e.g.,* managers and investors) and triangulating our results based on entrepreneurs' perspectives. Consequently, we urge further studies to delve deeper into this aspect, exploring the relationships among all relevant actors, not solely focusing on entrepreneurs. Finally, we encourage scholars to apply the TIS life cycle to other emerging technologies to identify comparable trends and thereby validate the existence of the selective phase.

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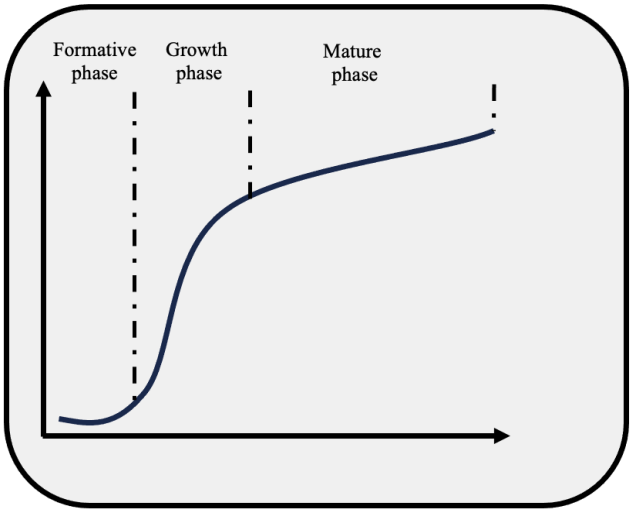
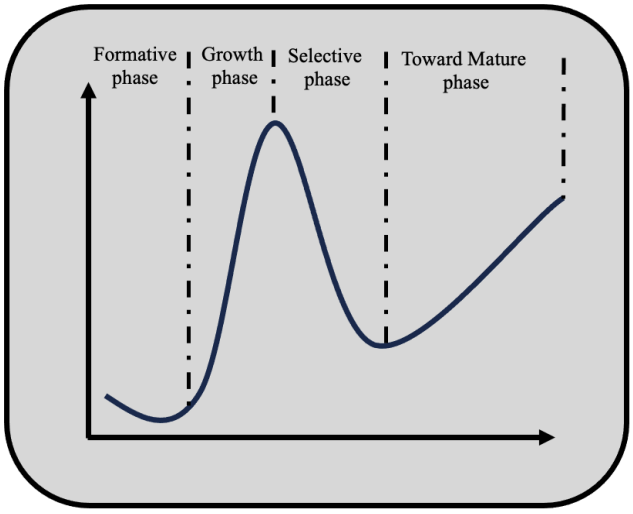
Appendix:

Figure 1. Revisiting the Markard (2020) model



Markard (2020) model



The Markard (2020) model revisited