

# Stakeholders and Value in the NFT Ecosystem

## Towards a Multi-disciplinary Understanding of the NFT Phenomenon

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### ABSTRACT

Non-fungible tokens (NFTs) have been a defining trend for design, technology, and business in 2021. The value, legitimacy, and utility of NFTs is disputed: proponents highlight revolutionary economic and cultural potentials of an open, secure, and immutable ownership database, while opponents are displeased by the environmental issues and abundant wrongdoing in the ecosystem. Nevertheless, the phenomenon is relevant to HCI, and signifies important developments for future interactive products. To better understand the NFT phenomenon, and to inform future HCI research and design, we investigated the stakeholders in the NFT ecosystem and relations between them. Based on open data we mined from the social news website Hacker News, we contribute the first data-backed model of stakeholders in the NFT ecosystem. The model reveals a nuanced account of the outlooks of creators, owners, and technologists; identifies investment firms and auction houses as arbiters of knowledge and value; and presents implications for future research.

### CCS CONCEPTS

• Human-centered computing;

### KEYWORDS

art market, blockchain, business, creator economy, cryptocurrencies, cryptography, digital art, economics, finance, NFTs, non-fungible tokens, startups, speculation, venture capital

### ACM Reference Format:

Mehmet Aydın Baytaş, Amos Cappellaro, and Ylva Fernaeus. 2022. Stakeholders and Value in the NFT Ecosystem: Towards a Multi-disciplinary Understanding of the NFT Phenomenon. In *CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '22 Extended Abstracts)*, April 29-May 5, 2022, New Orleans, LA, USA. ACM, New York, NY, USA, 8 pages. <https://doi.org/10.1145/3491101.3519694>

## 1 INTRODUCTION

The technological, cultural, and economic phenomenon of non-fungible tokens (NFTs) has been a defining trend for design, technology, and business in 2021, to the extent that the Collins Dictionary chose “NFT” as the word of the year [69]. Estimates for

the 2021 market volume for NFTs range between \$12B to over \$26B – an explosive increase over approximately \$250M in 2020 [4, 34, 43, 54, 55, 74]. To put this in perspective with other HCI-relevant markets: current estimates for yearly market volume are approximately \$18B for digital cameras [71], \$20B for microcontrollers [27], and \$13B for US-based graphic design services [38].

Technically, an NFT is a data entry in a distributed blockchain database that registers an ownership relation. NFTs are managed by smart contracts, i.e. computer programs stored on the blockchain. More than 97% of current NFT smart contracts are on the Ethereum blockchain [17], and follow the ERC-721 technical standard [26]. NFTs can be associated with a piece of digital media (e.g. image, video, music), but also physical property (e.g. real estate, artwork, land), loans, access keys, tickets, game items, etc. As blockchain data is open, immutable, distributed, and cryptographically secured, NFTs present a reliable ownership record; but current NFTs do not store any media – they merely bear a link to an asset or media, which may or may not be secure and immutable.<sup>1</sup>

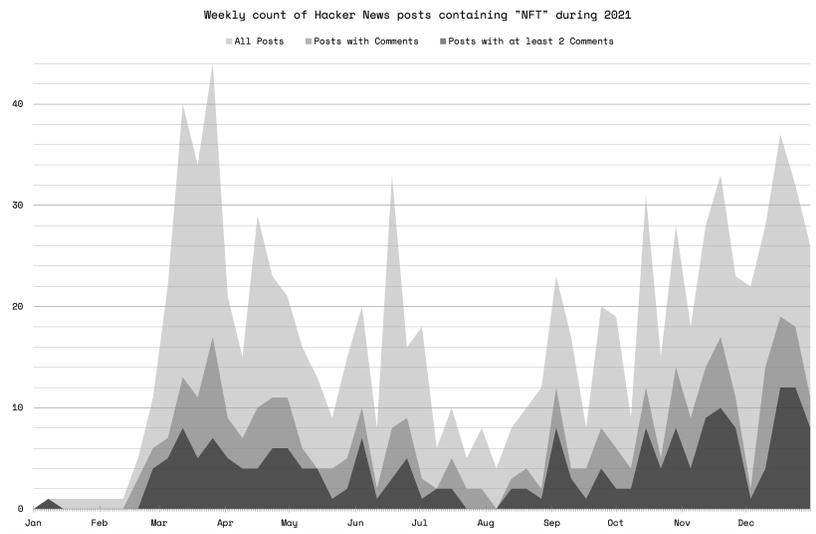
Many commentators argue that the 2021 NFT market is a speculative bubble (ongoing at the time of writing in January 2022), poised to crash in the near term. Evidence for this view includes unsustainable explosiveness of the growth, illegible value propositions, technical issues (e.g. energy costs), and significant proportions of fraud, plagiarism, manipulation, and misinformation in the ecosystem. Conversely, proponents are deploying significant investments into the ecosystem, arguing that NFTs will be increasingly significant over the long term due to promises of the underlying technology and the cultural value of NFT artifacts. In either case, NFTs are a phenomenon of interest for HCI, intimately connected to modern HCI topics, and heralding shifts in the technology, economics, and user experience of interactive products. It is worthwhile for HCI to investigate this phenomenon, to inform future design, development, and research – especially efforts to understand and serve its stakeholders, within and beyond the NFT ecosystem.

NFTs are a recent phenomenon, conceptualized in 2014 [20] and developed in a niche community until standardization in 2018 [26], until rising to renown in early 2021 via high-value sales by blue-chip auction houses [61]. Hence, though the topic has been covered from legal, finance, and engineering perspectives [1, 2, 24, 46, 57]; there is very little human-centered research to inform our understanding of NFT stakeholders. Related work focuses on potential use cases [6, 29], statistics [52], game design [29, 68], as well as impact on art and creative industries [30, 77, 83]. There

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*CHI '22 Extended Abstracts*, April 29-May 5, 2022, New Orleans, LA, USA

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ACM ISBN 978-1-4503-9156-6/22/04...\$15.00  
<https://doi.org/10.1145/3491101.3519694>

<sup>1</sup>Many NFT projects achieve immutability using platforms like IPFS which derives URIs from a cryptographic hash of their content (see: [docs.ipfs.io/concepts/content-addressing](https://docs.ipfs.io/concepts/content-addressing)). However, this is not consistent practice on platforms catering to non-technical users, and leads to confusion and misconceptions [47].



**Figure 1: Weekly count of Hacker News posts from 2021 matching “NFT”, showing the distribution of 899 posts in total. Of these, 200 with at least two comments formed the basis for our dataset, depicted here alongside 538 with no comments and 161 with a single comment.**

is little research on stakeholders, which can inform HCI design and research. To this end, we investigated the research question: *Who are the current stakeholders in the NFT ecosystem, what are their motivations, and what actions are they taking?* As our result we contribute a model which, to our knowledge, is the first data-backed mapping of stakeholders and relations in the NFT ecosystem. We also contribute research questions, implications, and approaches for future work.

## 2 RELATED WORK

Aside from the works cited above, our approach has been informed by Elsdén et al.’s work on a typology of blockchain applications for HCI, in terms of conceptual foundations as well as methodology [25]; and by Baytaş et al. (2018), who theorize on ensoulment (see: [7, 40]) and symbolic value for long-lasting “heirloom” designs on the blockchain [6]. Notably, the latter explains the unconventional economics and value propositions of NFTs, based on Veblenian economics and sociology [78], Verbeek’s philosophy of technology [79], and design research on the value of belongings.

Setting out with a research question similar to ours, Wilson et al. (2021) have drawn a “conceptual map” of the NFT ecosystem and its stakeholders [85]. Our work advances theirs in that: (1) they do not fully describe their data and methodology, while we have analyzed an open dataset (Sec. 3); (2) our data-informed model differs markedly from theirs (Sec 4); and (3) they highlight implications for management and innovation theory, while we focus on research.

## 3 OUR METHOD AND DATA

To gather knowledge on NFTs and stakeholders, throughout 2021, we followed diverse streams of information. This includes but is not limited to following thought leaders and prominent ecosystem actors on Twitter and Medium, joining relevant communities on

Reddit and Discord, and consuming relevant YouTube videos and podcast episodes. This approach was necessary and appropriate due to the rapid and emergent evolution of the subject – the knowledge we accessed in this way was not available elsewhere.

Thereafter, we turned to apply content analysis [45] on a dataset we mined from the popular social news website Hacker News<sup>2</sup> (HN) using the search term “NFT” for posts made during 2021. With its large volume<sup>3</sup> of content on technology and business topics, HN is appropriate data source for our research question in particular, and previous HCI-related research by Barik et al. [5] has set precedent for its usage as such.

Our search returned 913 posts spanning 2012–2021, of which 899 were from 2021. Figure 1 depicts the weekly distribution of posts. We used the number of comments made on each post as a proxy threshold for its information content, and omitted from our analysis 538 posts with zero comments and 161 posts with one. From the remaining 200 posts with at least two comments, we removed 7 duplicates, 2 broken links, and 8 off-topic or content-lacking posts; ending up with a dataset of 183 posts which we analyzed.

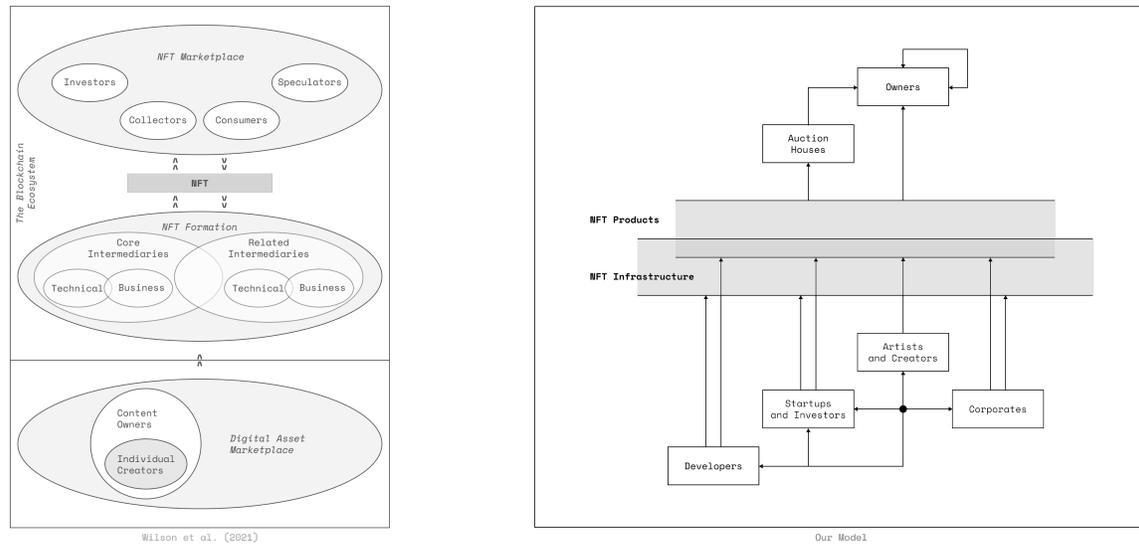
Most HN posts link to off-site content,<sup>4</sup> e.g. an online article or blog, social media post, open source code repository, or company website. We followed these links and reviewed the content of each to iteratively build and refine a set of stakeholder categories that we encountered. For each post, we recorded direct references and indirect allusions<sup>5</sup> to stakeholders in the content. Based on this, we referred back to the content to build descriptions of each stakeholder category, and to map relations between them.

<sup>2</sup>[news.ycombinator.com](https://news.ycombinator.com)

<sup>3</sup>The site reportedly has more than 5 million users [84].

<sup>4</sup>A minority of posts (30 out of 183 in our dataset) – prefixed “Ask HN” – do not contain a link but prompt a specific community discussion.

<sup>5</sup>For example, if a post mentions a successful auction, this implies that there are buyers involved; or if the post is a code repository, this means developers are involved.



**Figure 2: Left: NFT stakeholders and ecosystem relationships as identified by Wilson et al. (2021) [85]. Right: Our model of stakeholders and relationships in the NFT ecosystem.**

#### 4 STAKEHOLDERS AND RELATIONSHIPS IN THE NFT ECOSYSTEM

In our data, we found references to 6 salient categories of stakeholders we labeled *artists and creators*, *NFT owners*, *developers*, *startups and investors*, *auction houses*, and *corporates*. The categorization is primarily based on their shared motivations and actions, per our research question. Potential stakeholders we encountered but omitted due to their lesser engagement with the ecosystem include: art advisors, commentators, mainstream media, government, academic researchers, and IP owners whose work or likeness was exploited [22, 56, 62].

Wilson et al. (2021) have addressed the same question of stakeholders and ecosystem relationships – albeit with opaque methodology – and their results warrant comparison to ours. First, they identify *content owners* (IP holders) and *individual creators* as the originators of NFT artifacts. In our data, we found a more complex interplay of relations between artists and non-artist creators, developers, corporations, startups, and investors on the “supply side” of NFTs, where each of these categories have an agenda that is largely cohesive within the group, and distinct from the others. Second, they identify a somewhat complex structure of *intermediaries*, e.g. the Ethereum Foundation that maintains infrastructure, cryptocurrency exchanges, and startups who create NFTs (e.g. Dapper Labs<sup>6</sup>). We did not find representation of these actors as a cohesive category of intermediaries; and captured them our categories of developers, startups, and creators. Further, we found that auction houses – not included in Wilson et al.’s model – have been acting as important intermediaries with very consequential behaviors. Finally, Wilson et al. identify nuanced subgroups of NFT owners as *investors*, *collectors*, *consumers*, and *speculators*. In our data, we were unable to find sufficient nuance to distinguish between these subcategories, and we capture the “demand side” of the ecosystem simply as *owners*.

<sup>6</sup>dapperlabs.com

Below, we present the motivations and ecosystem contributions of each category.

##### 4.1 Artists and Creators

Artists and creators are by far the most prominent stakeholder class represented in our data, second only to NFT owners. However, compared to NFT owners, the motivations and actions of artist and creators are much better defined, as profiles, interviews, and stories were abundantly available [9, 28, 35, 61, 66, 72].

We distinguish artists and non-artist creators as two distinct groups in terms of their value propositions to NFT buyers: *Artists* create visual art and sell NFTs that are directly associated with the artwork. *Creators* perform in other domains (e.g. sports, science, engineering, comedy) and market NFTs for funding. Examples for the latter include UC Berkeley’s auction of research-based NFTs [64], meme creators [28, 31], and non-profits [32, 33]. That said, artists and creators often collaborate with each other – as well as with corporations, developers, and startups – and as such, there are significant intersections, relations, and permeability between the categories.

We found the following sub-categories of artists and creators represented, in terms of how they relate to NFTs:

- (1) Digital artists who are native to the medium, and have pioneered NFTs – e.g. Beeple [61], Pak [75].
- (2) Artists with roots in other media, taking up NFT opportunities – e.g. Vinnie Hager [44], Reuben Wu,<sup>7</sup> GMUNK.<sup>8</sup>
- (3) Artists focused on physical media, augmenting their value proposition by using NFTs to record provenance [9].

<sup>7</sup>reubenwu.com

<sup>8</sup>gmunk.com

- (4) Originals who surfaced as NFT makers, without obvious pedigree in the art world – e.g. Bored Ape Yacht Club (BAYC) [35], Larva Labs.<sup>9</sup>
- (5) Celebrities associating with NFTs for profit and/or charity – e.g. Grimes [41], Melania Trump [66], Quentin Tarantino [22], Tim Berners-Lee [15].
- (6) Internet-famous IP holders who tokenized their IP – e.g. “Disaster Girl” [28], “Overly Attached Girlfriend” [31].
- (7) Artists and designers who find jobs at startups and corporations that increased employing creatives in response to NFT opportunities [18, 19].
- (8) Scientists, non-profits, and others who market NFTs to finance their work [32, 33, 64].

The NFT phenomenon has been a boon for artists and creators, for a few reasons. First, the economic and cultural trend has radically expanded the demand for visual creative work, resulting in awareness, demand, and jobs. Second, NFTs can track ownership perpetually, and be programmed to earn a royalty for the originator whenever a secondary market sale is made – a novel and important opportunity. Finally, NFTs are a new channel that expands the “creator economy” [39, 50, 63], i.e. the technological possibilities that enable creative work to be compensated easily by consumers. In response, companies like Adobe are building NFT features into tools for designers and artists [14], illustrating but one direction in which HCI research can serve these stakeholders.

## 4.2 NFT Owners

The representation of NFT owners in our data is a curious case. They are the most salient stakeholder category in terms of implicit references: much of the content reports on sales and auctions, indicating that, somewhere, there exist buyers. However, direct representation is very rare, with only a handful of profiles, interviews, and reports turning to buyers as subjects. Worryingly, nearly all of these direct accounts report on scams, hacks, and other activity with owners as victims [3, 11, 36, 59, 72]. One exception discusses NFTs as Christmas gifts, albeit skeptically: “there’s no guarantee the person getting it will appreciate the gift and it could backfire, or at least be met with confusion” [42]. Another, investigating the motivations of an exuberant NFT buyer, alleges market manipulation [10].

What legitimate value propositions, other than speculative trading, lead to NFT purchases? We were able to access the answer through profiles of successful NFT projects like BAYC [35], business thought leaders [12], and gathering knowledge outside our dataset. We found the following value propositions of NFTs:

- (1) Games and virtual worlds implement NFTs as functional items, coupling gameplay to NFT ownership (e.g. Axie Infinity,<sup>10</sup> Cryptokitties,<sup>11</sup> Decentraland<sup>12</sup>). Industry research shows that gamers are interested in virtual items with monetary value, also in games that may not be blockchain-native [73].

- (2) Event tickets are an oft-cited use case. In our research, we have not encountered any examples of NFTs used to access physical spaces or services. However, in private conversations with industry insiders, we have found anecdotes of such usage at industry events, e.g. the 2021 gathering of Slush<sup>13</sup> in Helsinki.
- (3) Many NFTs explicitly provide access to virtual spaces, communities, and clubs – e.g. BAYC, Anti Collective.<sup>14</sup>
- (4) Profile picture (PFP) NFTs like Larva Labs’ Cryptopunks serve as prestigious symbols signaling wealth, innovation, entrepreneurship, and membership of an in-group.
- (5) NFTs reflect aesthetic and cultural tastes of collectors, leading to bonding and communities. During 2020-2021, cultivating local relationships based on culture and taste “in real life” was difficult due to social distancing. Displaying and trading NFT collections online is a substitute, to find such relationships globally.
- (6) NFTs are used as a payment system, instead of banking and credit cards, to compensate creators. Cryptocurrency owners prefer this due to lesser transaction costs, convenience, and/or ideology.
- (7) Decentralized autonomous organizations (DAOs) and other innovative institutions are emerging, with blockchain-native membership, benefits and governance mechanisms based on NFTs [8, 48, 51, 86].

Despite the abundance of potential NFT use cases, it is notable that real-world examples of legible value propositions like the above are few in our data. The narrative is dominated by the prominent projects we have cited so far, as well as speculative trading. What proportion of the market is driven by use cases, compared to speculation? This is a worthwhile question for future work, to be answered by market data and human-centered research.

## 4.3 Startups and Investors

This is a category of stakeholders that is an ecosystem of its own, composed of primarily private, founder-led, software-focused companies and venture capitalists. Examples include prominent NFT-native companies like OpenSea and Dapper Labs, along with venture capital (VC) firms like Andreessen Horowitz (a16z) and Y Combinator (YC). They are a highly interconnected network that is also integrated with developers, creators, and corporations; and it is difficult to classify individuals in the network as investors vs. operators – the roles are dynamic, and many in the network have significant financial stakes in other actors. Due to abundance of investment relations and the fiduciary duties that follow from them, it is prudent to say that startups and investors are financially motivated. However, their financial motives can be synergistic with genuine visions to transform the world to a preferred state (cf. [70, 88]).

Startups are significant in the ecosystem as they build the infrastructure and the NFTs – practically all NFT transactions throughout 2021 have taken place on OpenSea and other marketplaces built by startups [43], and the vast majority of value has accumulated in NFT projects built by startups.<sup>15</sup>

<sup>9</sup>larvalabs.com

<sup>10</sup>axieinfinity.com

<sup>11</sup>cryptokitties.co

<sup>12</sup>decentraland.org

<sup>13</sup>slush.org

<sup>14</sup>anti.co

<sup>15</sup>See: <https://nonfungible.com/>

Investors are significant not only because they provide the capital to make these possible, but also because they have significant influence on culture and narratives through thought leadership. a16z, for example, is a direct investor in 40+ blockchain startups including OpenSea, Dapper Labs, Coinbase, and Foundation; as well as the publisher of Future<sup>16</sup> – a highly influential resource that creates knowledge on the technologies they invest in. YC maintains HN, where our data comes from. A very significant amount of knowledge and narratives on NFTs are authored by individuals associated with VC – e.g. Dixon [23], McCormick [48–51], Xie [86, 87]; who are highly active content creators, explaining and promoting technological and economic visions that define the ecosystem as viewed by its participants and proponents.

These stakeholders wield significant influence on the NFT ecosystem, simultaneously influencing its technology and narratives. VCs, in particular, appear to have the means for driving significant financial value in NFT projects through credible and prolific thought leadership. The implication is that the vested interests of those who author knowledge in this ecosystem should be taken into account while studying it and/or developing for it; and more diverse work to create knowledge from different perspectives is needed to inform and democratize design and development in this space.

#### 4.4 Developers

Developers (devs) are identified as a category that is separate from creators and startups, due to two characteristics: (1) many undertake projects without salient personal connections to the other stakeholders (other than through the technical infrastructure), and (2) they present an outlook that is different from the financially motivated startups, investors, artists, and creators. While the previous supply-side stakeholders share a positive outlook, outspoken about the potentials and value of NFTs; many devs contribute or represent criticism, skepticism, and sober analysis. For example: Twitter user Jonty Wareing shares an analysis of how NFTs reference the assets they represent [81], and Revoy (2021) criticizes an NFT project based on his open-source work [62].

As HN is a computer science and engineering-oriented community, devs are the authors or protagonists of many posts in our data. These include comedy (e.g. Programmer’s Poop,<sup>17</sup> NFT THE DP<sup>18</sup>), open source (e.g. useNft,<sup>19</sup> nft\_ptr<sup>20</sup>), and projects foregrounding technical innovations (e.g. NFT Replicas,<sup>21</sup> bing.ly reverse NFT search<sup>22</sup>) Interestingly, there are comparatively few references to devs in other media, outside of hacking incidents [67, 76] and in relation to startups and corporations. We find this to be a somewhat worrying feature in a technology-centric ecosystem.

#### 4.5 Auction Houses

Auction houses present as extremely influential, in a market-defining role. Despite this, the role of auction houses is not foregrounded in the narratives in our data, and absent in related research. New

research is needed on the role of auction houses in the NFT ecosystem, as it is central to the economics, culture, and sociology of the phenomenon.

The remarkable feature in our data is that the subject of NFTs has not been taken up in HN until late February 2021 (see Fig.1), which corresponds to the announcement of the high-profile Beeple NFT sale by the blue-chip auction house Christie’s [61], realized at approximately \$69M. Of 913 HN posts matching “NFT” during 2012–2021, only 15 precede this event. This is remarkable, considering the HN community is composed largely of early adopters in business and technology, historically engaged with cryptocurrencies and blockchain applications. Our expectation would have been to see the technology and opportunities discussed in the months, if not years, leading up to this landmark event.

According to our data and our preliminary research on the structure and power relations in art markets [21, 60, 65, 82], it appears that a significant proportion of the financial value in the NFT market arises from the participation of auction houses like Christie’s [61] and Sotheby’s [37]. These actors present as authorities and arbiters of legitimacy, with strong direct influence on the pricing of artworks, as well as indirect influence on the demand side of the market via well-endowed sales and marketing tactics.

Current NFT research in art focuses on potentials [77, 83] and aesthetics [30], while quantitative research neglects the role of authorities like auction houses and VCs [46, 52]. Characterizing the influence of auction houses on the NFT market is an interesting topic for future work at the intersections of finance, economics, sociology, and art.

#### 4.6 Corporates

With this category, we capture established companies focused on non-NFT businesses. Examples include conglomerates like Nike [53]; gaming companies like EA [18], Epic [13], and Valve [16]; large tech industry players like Shopify and Meta; and media companies that are responsible for publishing much of the content in our data. The participation of these actors in the ecosystem is largely reactionary, and depends on what industry they anchor in. Patterns include:

- Post-startup software companies attempting to capitalize on blockchain trends, including NFTs, via extensive shifts in brand strategy – e.g. Meta (formerly Facebook), Block (formerly Square).
- Gaming- and creativity-related companies decisively integrating [13, 14, 18] or turning away from NFTs [16].
- Non-software companies taking up NFTs via marketing investments [19] or acquisitions [53].
- Large news and media outlets positioned as incumbents being disrupted by the creator economy (see Sec. 4.1).

Most corporates are followers rather than leaders in the ecosystem, and may be considered outside the scope of HCI. However, they are important for two reasons: (1) Their engagement with NFTs is taken by the public as a sign of legitimacy for the market as a whole, potentially driving value. (2) The actions of large companies elicit responses from the public, who in turn get representation in our data – e.g. as in the story of how GSC Game World announced and

<sup>16</sup>future.a16z.com

<sup>17</sup>programmerspoop.com

<sup>18</sup>nftthedp.com

<sup>19</sup>github.com/spectrexyz/use-nft

<sup>20</sup>github.com/zhuowei/nft\_ptr

<sup>21</sup>nftreplicas.net

<sup>22</sup>bing.ly

canceled plans for NFTs in an upcoming game, over fans' energy consumption and financial risk concerns [58].

## 5 DISCUSSION AND CONCLUSION

We have presented a model of stakeholders in the NFT ecosystem, which drove an important technological, cultural, and economic phenomenon in 2021. To our knowledge, this is the first model of its kind backed by open data, and advances previous work where data and methodology was opaque. As we presented our model above, we have also highlighted implications and recommendations for future HCI and interdisciplinary research.

Highlights from our findings include: a nuanced and data-backed examination of motivations and value propositions for NFT artists/creators and owners which can inform HCI; identifying VC firms as knowledge creators with vested interests and auction houses as arbiters of value, which calls for further research; and the surprising underrepresentation of developers and the general public in our data. One limitation of our study is our comparatively limited dataset, based on one social news website. Hence, our model should be taken as one possible perspective on the topic, rather than a conclusive explanation of the phenomenon. Future work can investigate similar questions on different datasets to build more inclusive models, and/or perform more advanced analysis which can involve quantitative features as well.

The jury is still out on the value, legitimacy, and utility of NFTs [80]. On one hand, it presents exciting opportunities for creatives, nonprofits, and innovators. On the other, concerns like the high energy cost of maintaining blockchains and wrongdoings in the ecosystem have merit. We hope that studies like ours can serve to illuminate both sides, to eventually overcome shortcomings and achieve the positive potentials of the technology. In the near future, we are expecting novel technical standards to succeed current ERC-721-based NFTs, towards applications beyond visual art.

## ACKNOWLEDGMENTS

This work has received funding from Vetenskapsrådet (The Swedish Research Council) via the Natural and Engineering Sciences Grant 2019-04826.

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