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“Right-click, Save As” is Dead; Long Live “Right-click, Save As”! – Understanding Profile Picture NFT Business Models in Web3

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“Right-click, Save As” is Dead; Long Live “Right-click, Save As”! – Understanding Profile Picture NFT Business Models in Web3

Completed Research Paper

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Abstract

Blockchain-based non-fungible tokens (NFTs) have heralded a new age of digital ownership, enabling business models across various applications. Representing non-interchangeable, physical or digital objects, particularly the subcategory of profile picture (PFP) projects gained considerable attention in 2021. However, a comprehensive analysis providing insights into the design of PFP business models is still missing. Therefore, we analyzed the business models of successful PFP projects in an iterative study. We combined a literature review with the empirical analysis of 60 projects, resulting in two outcomes: (1) A taxonomy that uncovers crucial dimensions and characteristics, and (2) five business model archetypes representing common combinations of these attributes. Our research provides insights into key patterns of PFP projects and their business models. We also enable practitioners to better understand and manage the opportunities and challenges associated.

Keywords: profile picture projects, non-fungible tokens, blockchain, business models, taxonomy

Introduction

Imagine a young artist who, following in the footsteps of Vincent van Gogh, creates digital paintings and drawings. Unlike conventional physical artwork, these works can be duplicated an infinite number of times, with no discernible difference between the original and a copy. However, the advent of non-fungible tokens (NFTs), which are blockchain-based tokens with unique properties such as counterfeit protection and proof of ownership, is changing the game in this regard. The phrase “right click, save as” in the paper’s main title refers to a common meme about the value of NFT art. It pertains to the fact that digital images can be saved as a digital copy. The meme is either used by people who don’t value NFT crypto art, claiming that by saving the digital copy they “own” the image as well. In satirical form, the meme is also used by the crypto art community to mock this very argument. NFTs have ushered in a novel era of digital ownership (Murray et al. 2023) and are consequently viewed as a catalyst for the advancement of Web3 (Colicev 2023). Web3

represents a blockchain-based, decentralized evolution of the World Wide Web (Li and Chen 2022). By revolutionizing the way value is created, shared, and monetized in the digital realm, NFTs offer innovative opportunities for businesses, creators, and users alike, leading to new revenue streams, enhanced customer engagement, and new forms of collaboration (e.g., Chalmers et al. 2022; Hartwich et al. 2023; Wilson et al. 2022). Integration into existing ecosystems is another significant aspect to consider: NFTs can be incorporated into pre-existing digital ecosystems, such as social media platforms (Guidi and Michienzi 2022), online marketplaces (Bamakan et al. 2022; Regner et al. 2019), and gaming (Wang et al. 2021). This integration serves to enhance user experiences, generate new revenue opportunities, and promote the growth of NFT-based communities (Chohan and Paschen 2023; Colicev 2023).

Within this context, profile picture projects (PFP projects), a sub-area of NFTs, have resulted in considerable hype surrounding projects such as Bored Ape Yacht Club and CryptoPunks. Over 1,000 PFP projects currently exist on the market, generally representing collections comprised of 10,000 images and widely used as profile pictures on social media. Due to their remarkably high sales prices, particularly in 2021, PFP projects have brought NFTs into the spotlight and increased their appeal as investment assets (Ante 2022). However, PFP projects possess a specific characteristic: Although NFTs are technically unique, the visual appearances of the NFTs within a PFP collection do not usually differ significantly. Hence, two profile picture images in collections such as the CryptoPunks may have only one differing attribute such as mouth, eye color, or beard (Hofstetter et al. 2022). Thus, although the tokens of this NFT subcategory are unique and exclusive in terms of technical implementation and projects, they also simultaneously possess a certain level of conformity. According to Hofstetter et al. (2022), this combination of properties is rarely found in other goods and thus requires further research.

However, as NFTs and their PFP subcategory have only recently gained prominence, there is limited knowledge and experience, along with a lack of frameworks of developing, implementing, and managing businesses based on these tokens, particularly across various industries (e.g., Ali et al. 2023; Bamakan et al. 2022; Hartwich et al. 2023). Therefore, challenges exist for entrepreneurs, organizations, and investors who want to leverage and monetize the new revenue streams and opportunities. Given the novelty of the NFT domain, the existing literature on NFT business models is limited. However, several conclusions can be drawn from the studies that are available: NFTs possess unique characteristics, such as non-fungibility, verifiability, transparency, usability (primarily ownership information), and tradability/transferability (Wang et al. 2021). These features have driven their widespread adoption across various industries, including art, gaming, virtual reality, and collectibles (Rehman et al. 2021).

However, a holistic and comprehensive analysis of NFT business models that transcends individual case studies has not yet been conducted. Consequently, the scientific community lacks cross-project and cross-company insights into the design and configuration of NFT business models. Previous research on blockchain-based business models has varied in scope and focus. Beinke et al. (2018) examined startups in the financial sector without delving into the technology used, while Weking et al. (2020) placed a relatively strong focus on technical aspects. Both studies found that blockchain technology has a significant impact on business models, providing valuable insights for academia and industry. The use of limited edition PFP collections enables completely new business concepts, such as the creation of digital personas, their use as status symbols within specific ecosystems, or the provision of special privileges to certain customer groups (Casale-Brunet et al. 2022). Therefore, we focus on the PFP subcategory to offer valuable insights and foundations for the (future) development of these digital assets. These insights encompass not only technical aspects but also economic considerations, with a specific focus on business models. In this study, we analyze the 60 most successful PFP projects¹ by sales volume to identify the elements that distinguish successful PFP business models. To provide valuable insights for both the scientific community and industry stakeholders, including companies and artists, we address the following research question (RQ):

RQ1: What elements comprise PFP business models?

The elements of the business models we have identified are presented in a taxonomy. Based on this taxonomy, we derive archetypes that represent business model patterns. These archetypes contribute to a

¹ Further information will be provided to interested readers if requested. The list of projects analyzed is available via Google Docs: www.bit.ly/3sP3bS4

better understanding of business models. Such an understanding is, according to Veit et al. (2014), of considerable benefit to the scientific and business communities. Therefore, we also address the following research question:

RQ2: Which are the dominant PFP business model archetypes?

The remainder of the article is structured as follows: First, we introduce the theoretical foundation, covering the fundamentals of NFT research as well as business models. Next, we present our research approach. Following this, we develop a taxonomy of business models for PFPs, and a cluster analysis to derive the resulting business model archetypes. We then discuss our findings and main contributions, while also acknowledging the study limitations. Our paper concludes with a summary of the findings.

Theoretical Foundations

Non-Fungible Tokens and Profile Picture Projects

NFTs are a new kind of blockchain-based tokens (Regner et al. 2019). “Fungible” refers to identical or interchangeable units such as coins and banknotes. “Non-fungible” tokens are unique units representing specific, non-interchangeable physical or digital objects, such as game items and artwork (Chohan 2021; Rehman et al. 2021). Ownership of an NFT can be shifted by trading or selling the token (Dowling 2022a). While some NFT collections offer trading platforms on their own websites, several marketplaces for NFTs such as OpenSea, Rarible, SuperRare, or KnownOrigin have emerged in recent years. As a result, NFTs allow content creators a new way to offer their artwork directly to customers on these marketplaces, independent of galleries or auction houses. Equally, for buyers, there are opportunities to make profits through increasing prices (Onete et al. 2022). In 2021, NFTs rose to market prominence and the interest of collectors and investors in NFTs soared (Pinto-Gutiérrez et al. 2022). As a result, the worldwide market capitalization of NFTs increased to 21.5 billion USD in 2021, which was almost 200 times the sum of all NFT transactions that had previously taken place (Tan et al. 2023). High-profile NFT projects such as Bored Ape Yacht Club and Doodles have contributed to the immense popularity of PFP projects (Casale-Brunet et al. 2022). These projects typically feature limited edition artwork collections, typically comprised of 10,000 pieces (Casale-Brunet et al. 2022). Owning an NFT from these collections may grant the buyer access to restricted social network groups, games, or exclusive events—in either the virtual or physical worlds. Consequently, these artworks are also regarded as digital status symbols and often used as profile pictures on social media platforms, spawning the term “profile picture projects” for this class of NFTs. Buyers of such NFTs receive a content license, and this allows them to use the art or content for various purposes. In some cases, such as Bored Ape Yacht Club, this license permits the NFT to be commercially used to create new content, art, or even business models based on the specific NFT (Lee 2021).

Business Model Research

Since the mid-1990s, the emergence of the “New Economy” has resulted in the increasing prominence of the business model concept, initiating a corresponding increase in academic interest; however, a uniform definition of the term has yet to be established (Krumeich et al. 2012; Osterwalder et al. 2005). Nevertheless, there is a consensus on what constitute the core principles of the concept. A business model outlines how companies create value, generate revenue, and the methods they employ to achieve these goals (Osterwalder 2004; Teece 2010; Timmers 1998). Illustrating the components of a business model clarifies the company's structure for both internal and external stakeholders, leading to an in-depth understanding of the business itself (Osterwalder 2004).

Central elements of business models can vary depending on the framework or approach. However, some key components that are generally considered crucial for understanding and designing business models include value generation, revenue streams, customer and market segments, distribution channels, resource management, and the cost structure (Massa et al. 2017; Osterwalder and Pigneur 2010; Wirtz et al. 2016). While understanding the central elements of business models is crucial, it is also important to consider how these models can be systematically categorized and analyzed (Pateli and Giaglis 2004), which is when business model taxonomies become relevant. In information systems, research taxonomies can provide a structure for specific fields and help to understand complex domains in which only a little knowledge is

available (Nickerson et al. 2013; Szopinski et al. 2017; Szopinski et al. 2019). A taxonomy enables the classification of certain objects in different dimensions according to a predefined system (Glass and Vessey 1995). It structures results, facilitates the handling of individual cases, and allows for general statements about the relationships or differences between specific objects. As a result, taxonomies lead to a better understanding of the field of study (Glass and Vessey 1995). The concept of taxonomies has already been applied in related research areas to organize and classify business models, ranging from specific use cases, such as car sharing, to cross-application uses of certain technologies or even the analysis of technology usage within a particular sector (Möller et al. 2022; Beinke et al. 2018; Remane et al. 2016; Schoormann et al. 2022; Weking et al. 2020). Recent studies on NFT business models have tended to focus on all available NFT projects, particularly those from within the industry. Kölbel et al. (2023) have developed a taxonomy based on 59 companies that create and sell NFTs. In contrast, Hartwich et al. (2023) established a taxonomy based on the literature, empirical project data, and expert interviews. Their study also includes both industrial NFT projects and PFP projects. In our research, we focus solely on PFP projects that were previously only considered in conjunction with other projects. In this way, we can provide a more in-depth analysis of business models for PFP projects to derive recommendations for action.

Research Approach

To determine the potential of PFPs, we analyzed the business models of real-world projects in terms of content and scope using a sequential procedure (Eickhoff et al. 2017; Remane et al. 2016). Our goal was to develop a taxonomy of business models and to identify different archetypes. We followed the approach of Nickerson et al. (2013), who proposed a seven-step approach for taxonomy development. In the first stage, meta-characteristics are defined that serve as the starting point for selecting further characteristics in the taxonomy. Simultaneously determining the meta-characteristics necessitates defining the purpose of the taxonomy. The authors define the goal of taxonomies as a set of dimensions and characteristics that are mutually exclusive and collectively exhaustive of each other so that every object only has one (Nickerson et al. 2013). Therefore, a taxonomy can be used to compare different properties of objects such as business models (Tönnessen et al. 2020). Due to the iterative approach of the method, objective and subjective ending conditions have to be chosen in the second stage, which serve to terminate the process if a desired result has been achieved. Nickerson et al. (2013) describe the subjective ending conditions as concise, robust, comprehensive, extendible, and explanatory. These conditions have to be met at a minimal level to terminate the process. The authors also define several possible objective ending conditions such as unique characteristics and dimensions, and no merging or adding of new dimensions and characteristics in the final iteration. The third stage is the decision to either use conceptual-to-empirical or empirical-to-conceptual as an approach for the first iteration. Conceptual-to-empirical means that dimensions and characteristics based on the first meta-characteristics are determined on the basis of literature research. The substeps for this approach are to conceptualize characteristics and dimensions of objects and examine further objects for these characteristics and dimensions. Finally, the taxonomy is created or revised before the ending conditions are tested. The empirical-to-conceptual approach works in reverse. In the substeps for this approach, (new) subsets of objects must be identified. In the next step, common characteristics and group objects are identified. Finally, these characteristics are grouped into the dimensions to create or revise the taxonomy. After these steps, the ending conditions are tested in each iteration. Once one of the two approaches has been applied, a first draft of the taxonomy with dimensions and characteristics should be available. If the ending conditions are not fulfilled after this iteration, the process begins again at the point of the approach decision that will lead to a new set of dimensions and characteristics. This process is repeated until the ending conditions are fulfilled (Nickerson et al. 2013).

In this paper, we analyzed the business models of successful PFP projects. For that reason, we selected the sales volume of the PFP projects as selection criterion for the analysis, using the *CoinMarketCap* website as a database for thriving NFT projects based on all-time sales volume as of September 30, 2022. From our perspective, using the sales volume offers several advantages: First, the value of NFTs depends substantially on the degree of interest in them (Onete et al. 2022) and a high sales volume indicates that investors are interested in a particular PFP collection. The business model plays a significant role in this interest, as it is a determining factor in how investors achieve returns, such as through the increased value of individual items. Second, more extensive data is typically available for projects with high sales volumes. This enabled us to enhance our data quality, as information can be cross-verified across multiple sources. The required

project data was collected using white papers and other documents published by the projects (e.g., the projects' websites, GitHub, and Discord) and the corresponding smart contracts. Due to incomplete data, especially for the older projects, the data was supplemented with sources such as the OpenSea page or social media accounts of the collections, videos, and articles, partly from news outlets or cryptocurrency exchanges. Data collection was conducted by two researchers who divided the search between them. For the purposes of mutual control and validation, more than 50% of the projects' data was researched by both researchers, the results were compared, and any discrepancies were discussed and/or revised. After the classification of all 60 NFT projects in our taxonomy, we performed the cluster analysis to identify different archetypes. The statistical procedure identifies fundamental patterns, or archetypes, by discerning typical patterns and shared traits among PFP business models. These archetypes serve to represent the individual business models of analyzed projects on an abstract level (Anton et al. 2021; Eickhoff et al. 2017), enabling a clear illustration of both similarities and significant differences between business models (Beinke et al. 2018). A two-step cluster analysis, following the approach of Punj and Stewart (1983), was employed to determine these business model archetypes. First, Ward's (1963) minimum variance method with interval squared Euclidean distance was applied as a hierarchical clustering technique. Next, the non-hierarchical k-mode clustering algorithm (Huang 1998) was used to create mutually exclusive subsets based on similarity (Ward 1963). To determine the clusters, we analyzed both the elbow criterion and the silhouette plot (Anton et al. 2021; Rousseeuw 1987; Yuan and Yang 2019). Both evaluation criteria indicated that a five-cluster solution was the most suitable.

Taxonomy Development

Dimension Selection and Iterations

Given the absence of a clear pattern for selecting business model dimensions in the literature, we chose to utilize the business model canvas as our foundation. Using Osterwalder's (2004) business model canvas, which is widely used in academia and business, we established the fundamental meta-characteristics and began identifying the initial set of dimensions. In this study, we included the meta-characteristics of value proposition, revenue streams, customer relationships, distribution channels, and key resources. The value proposition outlines the inherent value or benefit that the product or service provides to the customer. Revenue streams describe the mechanisms by which the company generates revenue from customers, such as subscription fees. Customer relationships refer to the strategies used by the company to maintain and improve relationships with its customers. Similarly, distribution channels encompass the various methods by which the value proposition can be effectively delivered to customers. Finally, we examined key resources, which include both tangible and intangible assets that are essential for the business to effectively deliver its value proposition. The customer segments were initially analyzed by us but excluded in the course of taxonomy development. The reason for this is that, to the best of the authors' knowledge, it is impossible to determine whether a company or an individual has acquired the PFP in question unless they disclose it individually. While the primary target group for PFPs are private individuals, it is worth noting that companies can also be involved in PFP acquisitions, often for speculative reasons. The remaining facets of the business model canvas — cost structure, key partners, and key activities — have been intentionally omitted from this analysis. There is one major reason for this: Certain pieces of information are unattainable through our current approach, such as a precise breakdown of the cost structure. To delve into this aspect, conducting interviews with the individual PFP projects could yield valuable insights.

Nickerson et al. (2013) suggest using the conceptual-to-empirical approach for the first iteration if little data is available but a significant understanding of the domain is present. Otherwise, they recommend using the empirical-to-conceptual approach if significant data is available, but the researcher has only a slight understanding of the domain. In the case of sufficient data and an adequate understanding of the domain, the authors suggest using individual judgment to decide which approach should be used first (Nickerson et al. 2013). Therefore, we began **iteration 1** with the conceptual-to-empirical approach because our objective was to pinpoint the concepts that already exist in related research (Möller et al. 2019). Our objective was not to provide an exhaustive overview of NFT research; instead, we specifically sought literature pertinent to our research goals and integrated it into our study. Therefore, we conducted a systematic literature review following the guidelines provided by vom Brocke et al. (2009) and Webster and Watson (2002). We searched the following databases: EBSCOhost, AIS Electronic Library, Scopus, and Google Scholar. We

employed the search terms: “Non Fungible Token” OR “NFT” AND “Business Model*” AND (classification OR types OR typology OR taxonomy). Through an iterative process of assessing relevance, we evaluated each article’s title, abstract, and full-text analysis to confirm that they satisfied our inclusion criteria. We excluded publications that concentrated on unrelated subjects and eliminated any duplicates. Specifically, we included English-language articles that discussed business model aspects (dimensions and characteristics) and pertinent technologies in the NFT domain, for example, blockchain. The aim of the literature review was not to present the entire body of literature on NFT business models in detail, but to summarize the key findings to date and provide a starting point for the taxonomy we developed. A total of 16 relevant papers were identified and used as the foundation for this paper and for the development of the taxonomy. This was followed by an evaluation with empirical data. For that reason, we switched to an empirical-to-conceptual approach in the **second iteration**. We began by analyzing the business model characteristics of the top 20 NFT projects and aligning them with those identified in our literature research to obtain an initial base of empirical data. In the substeps of this approach, we identified new subsets of objects and characteristics. Then, we grouped these into the dimensions from the first iteration. At this point, no ending condition was met. Therefore, we continued with an empirical-to-conceptual approach in the **third iteration**, adding 20 more projects based on the same ranking criteria to further substantiate our findings and to elucidate the changes. In this empirical step, we identified additional features that were not evident in the previous step. However, some features from the literature were not implemented in the analyzed projects in any way, as there were too many common characteristics between the PFP projects. However, the ending conditions had yet to be entirely met, necessitating another iteration. In **iteration 4**, we followed the same steps as in the two previous iterations, adding an additional 20 NFT projects to corroborate our earlier findings. We discovered even more similarities within the PFP NFT domain and removed a few characteristics, because these had direct dependencies on other characteristics and were not suitable as a differentiating feature. After not identifying any new dimensions or characteristics in this dataset, we reached a saturation point. Furthermore, the data quality declined after 60 projects and not all the required data could be obtained. Therefore, we established our final taxonomy in compliance with the rules for ending conditions (Nickerson et al. 2013).

PFP Business Model Taxonomy

Value proposition: Li and Chen (2022) and Wang et al. (2021) propose that one of the primary ways NFTs create value is by providing digital scarcity, accomplished through limiting the number of issued units (**determination of supply**). These limitations can pertain to a fixed maximum number of tokens (Chirtoaca et al. 2020), be time-bound, or the issuance can cease after a certain period of time (Popescu 2021). NFTs can be released as individual artworks, as a collection, or even in unlimited numbers. Usually, a collection consists of a specific number of pieces. Notably, 10,000 is the most prevalent number for PFPs (Casale-Brunet et al. 2022). In our analysis, the size of these collections varied significantly, with some projects from our dataset containing just over 3,000 to 5,000 NFTs, while another project included as many as 200,000 pieces. In iteration 4, we refined our categorization to “fixed number” and prepared for the cluster analysis by changing the wording to “high” (> 10,000) and “low” (<= 10,000). NFTs can generate **rewards** for holders through staking mechanisms or integration in play-to-earn apps and games (Flick 2022; Hartwich et al. 2023): Staking involves “locking away” NFTs—meaning they are inaccessible for use—for a specified period in exchange for a reward. In gaming, the play-to-earn approach has gained popularity by offering rewards for completing quests or spending time on platforms. In iteration 3, we added “passive” and “other” categories, as we discovered additional reward possibilities for holding or using NFTs in our dataset. For example, some projects provide special tokens on a daily basis for holding a particular NFT (passive reward). Moreover, there are other incentives for rewards, such as contributing to the community, developing the project, or accomplishing tasks. The **represented content**, such as collectibles, videos, artworks, and gaming items further contribute to the NFTs’ value (e.g. Ali and Bagui 2021; Wang et al. 2021). Additionally, NFTs can be associated with physical goods, access to communities, and other exclusive privileges (Chirtoaca et al. 2020; Li and Chen 2022). In our initial approach, we distinguished digital items from physical items. However, as we analyzed the data from the selected PFP projects in iteration 3, we included gaming items (such as equipment and avatars) to create a clearer differentiation. We also changed the term “digital items” to “digital content” to better encompass aspects such as access to Discord channels. In the final iteration, we removed the “physical items” category, as none were found in the analyzed PFP projects. Instead, we added the term “community access” (e.g., to private chat rooms, virtual worlds, or

events), as it was a frequently observed feature and, in our opinion, represented a distinct type of value separate from other digital content such as digital (animated) artwork or videos. **Fractionalizing** is also mentioned in the literature and enables smaller investors to invest in high-value assets or “blue-chip tokens” by acquiring portions of NFTs (Popescu 2021). However, we removed this feature in iteration 4 because it was not found in the projects we analyzed. In some projects, **airdrops** are issued to holders of certain NFTs (Hartwich et al. 2023; Li and Chen 2022). This means that NFTs or other tokens are distributed free of charge to the corresponding wallets or released for claiming by certain holders. This generates additional value for NFT holders and can be utilized, for example, to reward their loyalty. In our analyzed projects, we discovered that airdrops were also employed for promotional purposes or to draw attention to the project, community, or an event. In this paper, we examined whether the collection distributed airdrops in the form of additional NFTs or other tokens to the corresponding NFT holders (yes or no). In addition to using scarcity to create value, NFTs may also grant property **rights** or (exclusive) copyrights (commercial use rights) to the holder (Flick 2022; Li and Chen 2022). Some NFT projects, such as mfers, utilize a some rights reserved license similar to Creative Commons (Casale-Brunet et al. 2022). Our analysis of the terms and conditions or other relevant documents revealed differences among collections in this regard, thus, impacting the options available to NFT holders. In iteration 3, we added use rights due to the presence of unclear statements or restrictions in several projects and assumed this option when no information was available. Hence, our results differentiate between a Creative Commons license, commercial use rights (without distinguishing between exclusive or non-exclusive rights, applicable geographic zones, or sub-licensable rights), and use rights for personal, non-commercial purposes (such as being displayed in the holder's wallet, using a modified version as a profile picture, or featuring on a third-party platform).

Approach	Iteration 1		Iteration 2		Iteration 3		Iteration 4	
	Conceptual-to-empirical	Empirical-to-conceptual	Empirical-to-conceptual	Empirical-to-conceptual	Empirical-to-conceptual	Empirical-to-conceptual	Empirical-to-conceptual	
Meta-Characteristics	Dimension	Characteristics	Dimension	Characteristics	Dimension	Characteristics	Dimension	Characteristics
Value proposition	Determination of supply	fixed unlimited	Determination of supply	fixed unlimited	Determination of supply	high low	Determination of supply	high low
	Rewards	staking play-to-earn	Token rewards	staking play-to-earn passive other	Token rewards	staking play-to-earn passive other no	Token rewards	staking play-to-earn passive other no
	Represented content	digital items physical item	Represented content	digital content physical item gaming items	Represented content	digital content gaming items community access	Represented content	digital content gaming items community access
	Airdropping	yes no	Airdropping	yes no	Airdropping	yes no	Airdropping	yes no
	Fractionalized	yes no	Fractionalized	yes no	Fractionalized	yes no	Fractionalized	yes no
	Rights & licenses	commercial rights creative commons license	Rights & licenses	use rights commercial rights creative commons license	Rights & licenses	use rights commercial rights creative commons license	Rights & licenses	use rights commercial rights creative commons license

--- New dimension from current iteration

Figure 1: Iterative Taxonomy Development – Dimensions of Value Proposition

Revenue stream: A primary source of revenue is the income generated from initial sales or minting. The **initial pricing** can vary significantly; for instance, CryptoPunks NFTs were initially available for free (Schaar and Kampakis 2022), while others were sold at a fixed price (e.g., NBA Top Shot packs, Zaucha and Agur 2022) or through auctions with dynamic pricing that could either ascend or descend over time (Guadamuz 2021). No additional characteristics were discovered in our analyzed projects. Another important consideration is the choice of **payment currency**, which determines whether NFTs can be purchased using fiat currency (e.g., NBA Top Shot packs, Zaucha and Agur 2022) and/or cryptocurrencies.

Since all the analyzed NFTs could be minted using cryptocurrencies, we removed this dimension from our analysis. Additionally, revenue can be derived from royalties (Li and Chen 2022). Royalties are fees charged when an NFT is sold on the secondary market, calculated as a percentage of the sales price, and typically paid to the creator or the project. Not all NFT projects impose such fees, hence, our initial segmentation included “yes” and “no.” For our cluster analysis, we further divided the “yes” option into “high” ($\geq 5\%$) and “low” ($< 5\%$), with the “no” option representing 0%. Approaches for the **initial type of distribution** include, for example, auctions or airdrops (Hartwich et al. 2023). In contrast to the aforementioned airdrops under “value proposition,” which reward holders, for example, by granting them additional tokens for owning or using a certain NFT, the issue of the NFT itself is involved in this kind of airdrop. In other words, the way in which the analyzed PFP collection itself is released onto the market or into circulation. Additionally, public NFT mints are available in which anyone can participate (public sale/public auction), sometimes with restrictions on eligible buyers. We added whitelist/pre-sale to iterations 3 and 4, as these distribution methods were more commonly observed in follow-up projects.

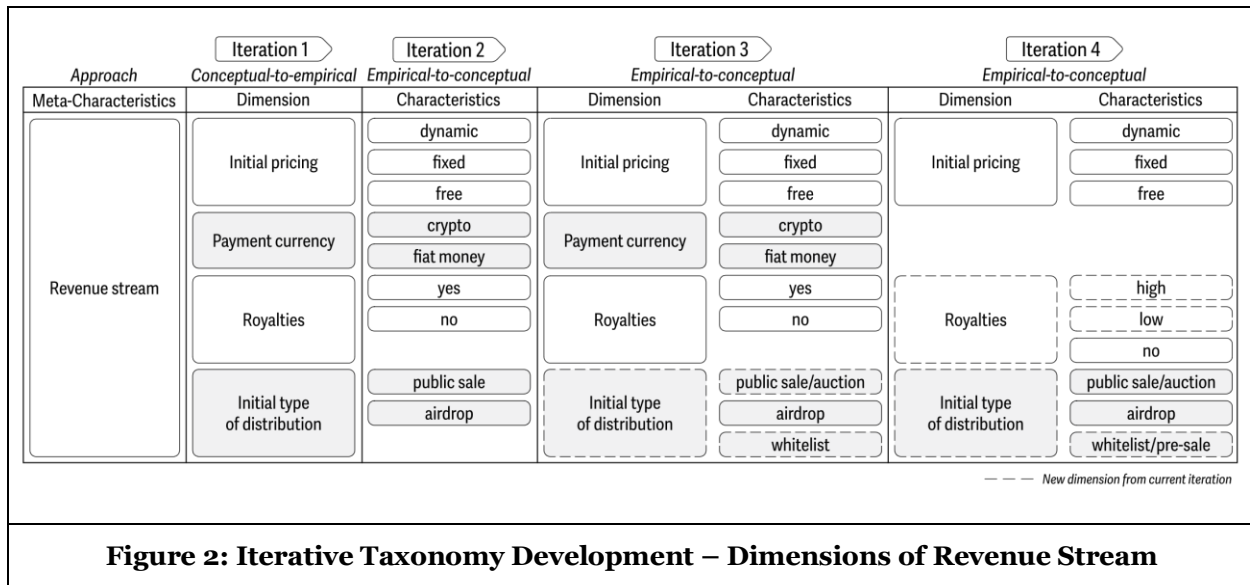
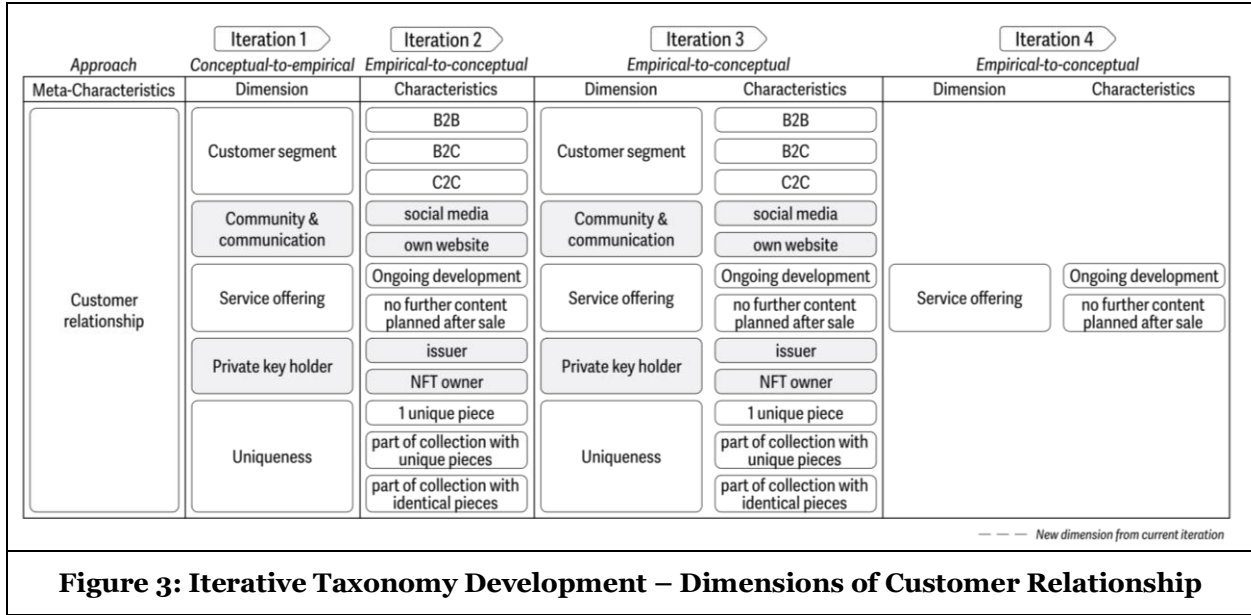
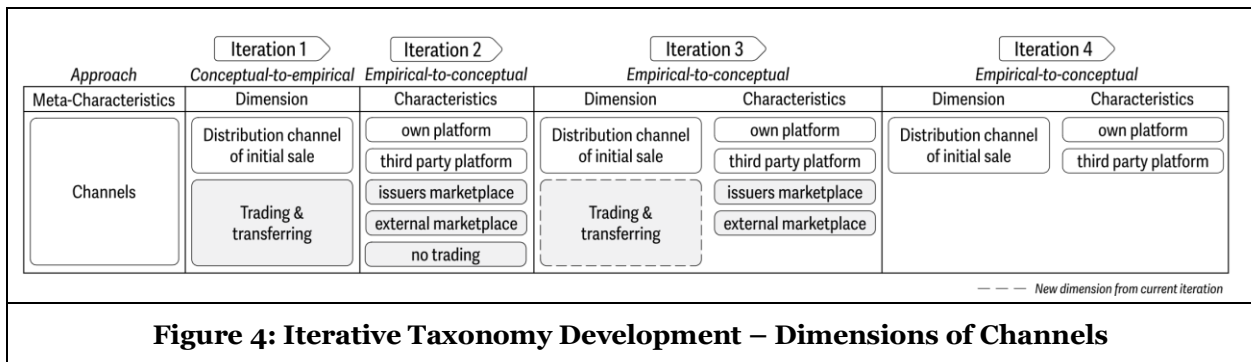


Figure 2: Iterative Taxonomy Development – Dimensions of Revenue Stream

Customer relationship: In their study, Beinke et al. (2018) demonstrated that customer segment (market segment) played a significant role in the cluster analysis of blockchain-based business models within the finance sector. This characteristic was therefore initially included, but dropped in iteration 4, as we found no clear distinction between the groups of B2B, B2C, or C2C. A clear allocation was thus not possible in any meaningful way. Chandra (2022) highlighted the importance of **communities** promoting their culture through chat platforms, citing a culture of sharing, knowledge exchange, and mutual learning as key elements of NFT communities. Since all PFP projects in our analysis communicated through both channels (social media and websites) to engage with holders, we dropped this aspect as it did not expose any differences between the projects. Another distinction can be made in terms of the further development of the NFT's ecosystems (**service offering**). For example, some projects, such as Bepple's work “Everydays: The First 5000 Days,” are sold on a one-time basis (Lyubchenko 2022). The content and details of such NFT projects are clearly defined from the beginning and are not extended. In contrast, PFP projects with a strong community focus provide continuous project development and deliver new content or ongoing benefits for NFT holders, which may not be (fully) announced at the time of the initial sale but determined over time (e.g., surprise airdrops, events, new partnerships with benefits for NFT holders, development of virtual worlds). In previous research, Sharma et al. (2022) highlighted that building a community early and maintaining high engagement play important roles in the success of NFT projects. Finally, to transfer NFTs, holders need the corresponding **private key** (Wang et al. 2021). While NFT owners can manage this key themselves using wallets, emerging service platforms allow users to log in with a username and password, thus, assuming key management responsibilities for the owners. We removed this dimension completely, as only one of the characteristics applied in the analyzed projects.



Channels: NFTs can be issued through different **distribution channels** during their **initial sale**. They may be offered peer-to-peer on a project’s website, directly with no intermediaries between creator/issuer and buyer, or on NFT marketplaces (Ali et al. 2021). Li and Chen (2022) point out that many creators and brands in practice rely on the expertise of intermediaries or third parties for their NFT launches, who accept fees for these services. NFTs can be **traded** and swapped (Ali et al. 2021) with **transferring** transactions taking place on external platforms or publishers’ websites. However, NFTs may also be restricted in terms of transferability, for example, transfers to external marketplaces (or self-hosted wallets) are not possible or only a certain number of transfers or a certain period may be allowed, or transfers may be completely limited (Hartwich et al. 2023). In iteration 3, “no trading” was removed because we found that there were no restrictions in the analyzed projects. Since we did not find any projects with restrictions regarding external marketplaces and transferring in iteration 4, we also removed the dimension of trading and transferring.



Key resources: Blockchains are the essential resources needed to build an NFT scheme (Wang et al. 2021). This underlying distributed ledger is a specific type of database used for storing NFT data, such as the smart contract that enables the NFT and provides a basic description of the functions and properties, or ownership information (Martin and Kellar 2021; Wang et al. 2021). Ethereum is the most widely used blockchain among NFTs (Fairfield 2022). However, side chains such as Polygon or alternative chains such as Solana have also been employed for NFTs due to certain properties or limitations of the Ethereum network (Flick 2022). Most of the analyzed projects in our data set used Ethereum. Metadata and a token’s **content**—in the case of the analyzed projects in the form of images, animated files, videos, avatars, and gaming items—can either be **stored** “on-chain” on the blockchain or “off-chain,” meaning in an external database (Cornelius 2021). In the latter case, a link pointing to the storage location of the relevant data and

files, which can be centralized (e.g., a company’s server/cloud storage) or decentralized (hosting the media files across multiple nodes, e.g., using the InterPlanetary File System), is typically used (Wang et al. 2021; Flick 2022). Therefore, in iteration 3 “off-chain” was divided into “off-chain & centralized” and “off-chain & decentralized”. As described above, we made several changes and additions to PFP characteristics.

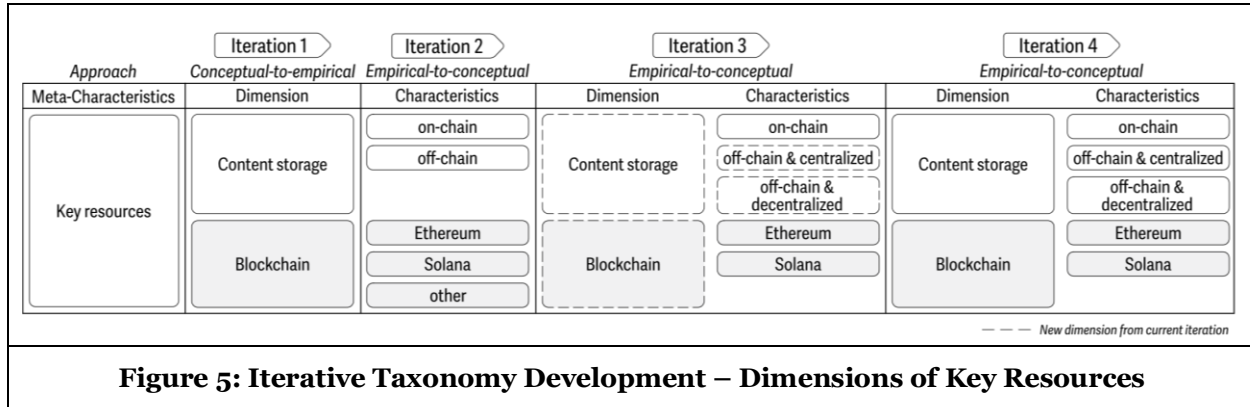


Figure 5: Iterative Taxonomy Development – Dimensions of Key Resources

Application and Archetypes

Assessing and validating the resulting artifact is a critical step in taxonomy development (Nickerson et al. 2013; Szopinski et al. 2019). We evaluated the suitability of the taxonomy by applying it to real-world objects such as business models, which is a frequently employed evaluation approach in taxonomy research (Szopinski et al. 2019). Each of the **five identified clusters** has several distinctive features regarding the dimensions and characteristics from our previously developed taxonomy and contains four to 20 of the analyzed projects (cf. Figure 6). Some characteristics are mutually exclusive, for example, supply cannot be both high and low in a project at the same time. However, in certain dimensions, projects can possess multiple characteristics. For instance, in the case of distribution, an exclusive whitelist sale for a specific group of individuals may precede a public sale of the remaining NFTs. From our perspective, this does not conflict with the attributes of a taxonomy according to Nickerson et al. (2013), since an additional characteristic could be added for each combination to ensure mutual exclusiveness in our cluster analysis. To keep Figure 6 succinct, we added information concerning whether a dimension’s characteristics are mutually exclusive (me) or not (nme). Consequently the cumulative percentages in some dimensions (price, distribution, channel, rewards, and content) surpass 100% for each cluster. This was taken into account in the cluster analysis.

Cluster 1 (“Business Pioneers”): Overall, the first cluster of collections is characterized by a low supply (max. 10,000) as well as off-chain and decentralized storage. Holders are granted commercial use rights, enabling them to start businesses based on their NFT rights. One example of how the collection’s community can derive value from the transferred rights is the burger restaurant Bored & Hungry in California, which opened in 2022. The owner is the holder of a Bored Ape, which serves as the restaurant’s logo. The concept, originally conceived as a 90-day pop-up restaurant, will continue to operate on a permanent basis due to its success (Chang 2022). Airdrops, an ongoing development of the ecosystem and high royalty incentive to hold these NFTs. Additionally, communities play a major role. The content of these NFTs rarely includes gaming components, and reward systems, such as staking or tokens for activities, are only used in a few projects. Examples of collections in this cluster include Bored Ape Yacht Club, Azuki, Doodles, or World of Women, which showcase the characteristics and business practices of cluster 1. World of Women, for instance, is a collection that represents the vision of building an inclusive Web3 by means of its community and increasing diversity and female activity in the NFT space. With this statement, World of Women has been able to attract celebrities such as Eva Longoria and Reese Witherspoon as owners. The Bored Ape Yacht Club, perhaps one of the most famous collections, has also attracted celebrity buyers. Through a variety of events, private content, and commercial rights, the collection makes owners feel as though they are part of an exclusive community. The collections in this cluster are striving to become more than just digital images, but rather status symbols or their own brands, by constantly evolving their activities and ecosystem.

			Number of projects									
			Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5	
Dimensions	Characteristics	# 20		# 11		# 14		# 11		# 4		
		#	%	#	%	#	%	#	%	#	%	
price	nme	fixed pricing	17	85%	10	91%	8	57%	10	91%	2	50%
		dynamic pricing	3	15%	1	9%	8	57%	3	27%	0	0%
		free	2	10%	1	9%	9	64%	0	0%	2	50%
distribution	nme	public sale / public auction	19	95%	10	91%	11	79%	9	82%	3	75%
		whitelist / pre-sale	6	30%	2	18%	5	36%	11	100%	0	0%
		airdrop	0	0%	0	0%	9	64%	0	0%	1	25%
channel	nme	own platform	18	90%	11	100%	14	100%	11	100%	3	75%
		service of third party	2	10%	0	0%	1	7%	0	0%	1	25%
supply	me	low	19	95%	9	82%	3	21%	9	82%	4	100%
		high	1	5%	2	18%	11	79%	2	18%	0	0%
rewards	nme	no	14	70%	5	45%	9	64%	9	82%	4	100%
		staking	1	5%	2	18%	2	14%	1	9%	0	0%
		passive	3	15%	2	18%	2	14%	0	0%	0	0%
		play-to-earn	0	0%	4	36%	1	7%	1	9%	0	0%
		other	2	10%	1	9%	1	7%	0	0%	0	0%
rights	me	commercial	14	70%	7	64%	7	50%	0	0%	2	50%
		use rights	4	20%	4	36%	5	36%	9	82%	1	25%
		creative commons license	2	10%	0	0%	2	14%	2	18%	1	25%
airdropping	me	yes	19	95%	9	82%	8	57%	10	91%	0	0%
		no	1	5%	2	18%	6	43%	1	9%	4	100%
service offering	me	Ongoing development	20	100%	11	100%	14	100%	11	100%	0	0%
		details specified	0	0%	0	0%	0	0%	0	0%	4	100%
blockchain	me	Ethereum	20	100%	11	100%	13	93%	11	100%	3	75%
		Solana	0	0%	0	0%	1	7%	0	0%	1	25%
content storage	me	off-chain & decentralized	18	90%	9	82%	3	21%	9	82%	3	75%
		off-chain & centralized	1	5%	2	18%	11	79%	2	18%	0	0%
		on-chain	1	5%	0	0%	0	0%	0	0%	1	25%
royalties	me	no	0	0%	0	0%	1	7%	0	0%	3	75%
		low	3	15%	1	9%	3	21%	0	0%	1	25%
		high	17	85%	10	91%	10	71%	11	100%	0	0%
content	nme	digital content	19	95%	10	91%	14	100%	11	100%	4	100%
		gaming items	1	5%	11	100%	3	21%	2	18%	0	0%
		community access	17	85%	10	91%	13	93%	10	91%	3	75%

Figure 6: Archetypes of PFP Business Models
me = mutually exclusive; nme = not mutually exclusive

Cluster 2 (“Gaming”): In this cluster, all the NFTs contain content related to gaming. For example, this may be access to a virtual world or use of NFT digital artwork as an avatar. Rewards are correspondingly common, especially play-to-earn and airdrops. This cluster includes collections such as VOX Collectibles Town Star or NFT Worlds (now Topia). In addition to collections issued specifically for online worlds, other gaming-related utility components are used to attract customers. For example, some of the more creative utilities are rewards that can be used to assign a name to the NFT’s profile image or “breeding” NFTs, which means that new NFTs or items can be generated by holders under certain circumstances. Community is also important; for example, in some collections holders are encouraged to experience adventures (together with other holders). Continuous further development of the project (e.g., own virtual worlds or games) is also part of the business model in this cluster and can be found in every collection.

Cluster 3 (“FOMO & Flipping”): This group is characterized by a high level of supply, which is not only distributed through public sales, but also as airdrops. Identical to cluster 1, the projects are also characterized by ongoing development and a strong community focus. However, a striking difference to cluster 1 is the centralized off-chain storage. In addition, the NFTs’ initial pricing systems include a high proportion of dynamic pricing mechanisms and also free mints, while in cluster 1 the initial distribution was predominantly at a fixed price. Almost all collections that were issued as airdrops to holders of already existing collections can be found in cluster 3. For this reason, it is noticeable that cluster 3 contains a number of follow-up projects such as World of Women Galaxy, Mutant Ape Yacht Club, Otherdeed for Otherside, CyberKongz VX, or VeeFriends Series 2. Thus, onboarding and an expansion of the community were enabled for people who missed out on the first wave of popular collections. In this context, the term “FOMO” (fear of missing out) is often used to describe a person with feelings of not knowing or missing out

on something life-enhancing (Przybylski et al. 2013). However, with the central storage of the content, an aspect that is important for Web3 advocates has been omitted. It is therefore debatable whether the drops of these collections also addressed so-called “flippers” as the target group, that is, those more interested in making quick profits through sales (Mackenzie and Bêrziņa 2022). From the perspective of the creators and issuers, the follow-up projects can also be seen as a source of income for the project's ongoing development. The additional funds are generated not only by the initial sale, but also by the high royalties from resales on the secondary market.

Cluster 4 (“Hype Chasers”): It is remarkable that all the projects in this cluster distribute at least parts of their collection via whitelists/pre-sales. In combination with the low supply, this creates an air of exclusivity for the projects. However, the holders are mostly only entitled to use rights; sometimes they have a creative common license. The storage of the NFT content is realized off-chain and decentralized. High royalties, access to an exclusive community, and airdrops encourage people to hold these NFTs. Ongoing development is also part of the business model. However, rewards are rarely found in this cluster. The initial distributions were mostly implemented with fixed prices, and in some cases dynamic price components were added. Projects in this cluster have typically started quite late, that is, during or shortly after the peak of the NFT hype at the end of 2021. Presumably, we can observe the “jumping on the bandwagon” phenomenon in this cluster, which is further substantiated by the appearance of two collections that seek to resemble the successful Bored Ape Yacht Club project through the use of monkey images (HAPE Prime, Prime Ape Planet). In addition, this cluster includes collections by artists such as Zipcy's SuperNormal or Murakami.Flowers, but also collections such as Capsule House and MURI by Haus.

Cluster 5 (“Enjoyment of Art”): The most noticeable characteristic of cluster 5 is that the content and details are precisely specified from the outset in all the collections. The business model does not include any development of the projects as in clusters 1 to 4. Therefore, neither rewards nor airdrops are issued to holders. Neither are any events organized. All the collections have low supplies and no or low royalties for resales on the secondary market. The NFT content is stored in a decentralized way (on- or off-chain). The projects contain collectibles/artworks that were initially distributed with a fixed price or for free. No gaming-related content can be found in this cluster. The cluster is only concerned with the digital artwork and the community, hence, these are NFTs without frills.

Discussion

Our study sheds light on the business models, practices, and strategies of successful PFP projects. To achieve this, we initially reviewed the limited body of literature on the NFT business model domain and analyzed 60 PFP projects to identify their properties and features. After developing a PFP business model taxonomy, we conducted a cluster analysis. As shown in Figure 6 there are noticeable differences among the respective clusters, leading to the identification of five distinct archetypes for PFP business models. Our study thus expands upon previous research (Hartwich et al. 2023) and NFT case studies (Dowling 2022b; Horkey et al. 2022), providing cross-project and cross-company insights into the design and configuration of PFP business models for both the scientific community and practitioners (Li and Chen 2022).

Implications for science: First, our results highlight the design of business models using PFPs. By employing an approach that analyzes both literature and real-world PFP projects, our study provides a detailed taxonomy of the distinct elements characterizing business models based on a specific NFT subcategory (RQ1). In this way, we follow Kölbel et al. (2023), who suggest focusing on a specific domain or sub-aspect of NFTs to increase the level of detail of the NFT taxonomy. Second, our study reveals distinctions between the identified archetypes and outlines their relevant and typical dimensions and characteristics (RQ2). Focusing on the PFP subcategory and linking token characteristics with business models and insights into real-world applications of successful projects, our research exceeds previous NFT classifications (i.e., Hartwich et al. 2023; Kölbel et al. 2023). This expansion towards a more holistic comprehension of PFP business models aligns with the call for additional research in the relatively young field of NFTs (Regner 2019; Bao and Roubaud 2022). Even though we focus on the PFP subcategory, we build on Kölbel et al. (2023), who have proposed the development of archetypes based on their NFT taxonomy as a future research field to derive successful or sustainable NFT designs. Throughout our iterative analysis, we found that PFP projects share numerous features while also differing from (industrial) projects outside the PFP subcategory. The analyzed projects did not exhibit the same broad dimensions and

characteristics as previously identified in the literature (Hartwich et al. 2023; Kölbel et al. 2023). For instance, fractionalized tokens (Popescu, 2021) were not found in the analyzed projects because the Ethereum standards ERC-721 and ERC-1155 do not support fractionalized NFTs (Bamakan et al. 2022). In addition, no projects with physical products or fiat payment options were found (Kölbel et al. 2023), which are implemented in some industrial applications: Owners of Adidas NFTs Into the Metaverse (Phase 1) were able to claim exclusive physical merchandise (adidas.com/metaverse). The platform VeVe, on which Disney launched its first official NFT collection “Disney Golden Moments,” also allows payments with credit cards and therefore fiat (veve.me). A common feature across all the analyzed projects is that the NFT owner also holds the private keys. This allows NFTs to be transferred to unhosted or self-hosted wallets that are owned and managed by the holder. Since this process demands a certain level of cryptocurrency knowledge and skill in handling wallets and tokens (Colicev 2023), it is evident that advanced, internet-savvy crypto enthusiasts constitute a significant target group. The same characteristic (private key holder) also allows the NFTs of the analyzed projects to be traded and sold on third-party marketplaces without restrictions. This paper also contributes to the body of literature in the field of business model taxonomies, which is still relatively young (Möller et al. 2022). As outlined in a meta-analysis by Möller et al. (2022), there are several “blank spots” in business model taxonomy research, which they encourage others to amend. Therefore, this study not only expands knowledge of blockchain-based business models but also creates new potential (sub)categories, as PFP NFTs encompass untapped areas such as art or gaming.

Implications for practice: Web3 provides companies with potential new markets and innovative value creation possibilities owing to the emerging forms of digital ownership. Gucci or Coca-Cola are examples of brands that have already entered the Web3 sector and released their own NFTs (Kim 2021). Consequently, Murray et al. (2023) anticipate an increase in market entries across various industries. Our study demonstrates that PFP business models can be successfully established in a variety of sectors, targeting art experts, collectors, gamers, fan communities, and NFT enthusiasts as target groups. Moreover, our research offers a framework that assists companies and creators in engaging with Web3 applications and opportunities, as well as in comprehending PFP business models. The five identified archetypes of PFP business models provide an overview of the essential elements and patterns of PFP projects. For individuals interested in entering the NFT business, our taxonomy presents an analysis of current PFP business models. Industry stakeholders can build upon our taxonomy and its patterns to evaluate the feasibility of implementing their own PFP projects, considering both opportunities and potential obstacles. Such an approach enables the consideration of relevant characteristics for a project and allows a company's model to be compared to those of competitors or the cluster's benchmark (Staub et al. 2021). The taxonomy can also serve as a creative decision support tool for identifying and selecting a company's implementation options (Tönnissen et al. 2020). Consequently, our study may inspire practitioners to innovatively transform their business models to target a more specific group of users and to discover unexplored “economic niches” within their ecosystem (Beinke et al. 2018). Additionally, the five archetypes illustrate the potential impact of PFP business models on both holders and brands. This impact may occur, for instance, when commercial usage rights are transferred to NFT holders (as seen in cluster 1). The results show how the selection of characteristics (e.g., rewards, royalty levels, storage, further development of the project, and supply) may be used to influence the use and holding periods of NFTs, and thus to address specific industries and target groups.

Moreover, our taxonomy serves to expand the conceptual foundations for **future research** in the domain of NFT business models. By providing a basis for a shared understanding of PFP business models, it facilitates future research in this area. Research on NFT business models is still in its early stages and will continue to evolve. Further research can build on our taxonomy and archetypes for further empirical studies of a qualitative or quantitative nature. The taxonomy and archetypes can serve as a starting point for further focused research, for example, on the success factors of various business model configurations. Cluster 3, for instance, contains a number of follow-up projects from previously successful PFP collections. These projects appear to boast significantly higher supplies than the first collections. Such trends and the success achieved by these follow-up collections could be the subject of further research. Furthermore, NFT design and business models outside the PFP subcategory, with a focus on specific industries, or a customer-centered perspective on NFTs could also provide interesting insights into the new research field of NFTs.

Conclusion and Limitations

The emergence of NFTs and PFPs is revolutionizing the landscape for creators and brands alike. Unlike Van Gogh, contemporary artists can now establish deeper connections with fans and buyers, thereby fostering thriving communities. Since NFT and PFP business models are a relatively young and rapidly evolving market, it is difficult to establish a fully comprehensive taxonomy. Under these circumstances, our taxonomy can be neither perfect nor all-encompassing and may require adaptation and expansion to include characteristics and insights as the markets evolve. The projects were selected based on sales volume. The results of such a selection have high volatility and are also limited by the websites' data partners, for example, to certain blockchains. Despite the validation provided by using a variety of analysis websites and other sources to ensure that the selected projects are indeed relevant collections in terms of sales volume, some relevant PFP collections may not have been included in our sample. Following from that, we also acknowledge that we have selected a specific timestamp of the analyzed projects. Therefore, previously successful projects or ones with a unique selling point from the past may have been omitted because our criterion for success is the all-time sales volume, as these projects offered a robust basis for information. However, it is worth noting that we analyzed consistently successful projects to derive a meaningful taxonomy that can assist in the creation of successful PFP projects. Conversely, it may be worthwhile to conduct a study on failed projects to provide recommendations on what to avoid when creating PFP NFTs.

References

- Ali, M., and Bagui, S. 2021. "Introduction to NFTs: The Future of Digital Collectibles," *International Journal of Advanced Computer Science and Applications* (12:10), 50–56. <http://dx.doi.org/10.14569/IJACSA.2021.0121007>
- Ali, O., Momin, M., Shrestha, A., Das, R., Alhajj, F., and Dwivedi, Y. K. 2023. "A Review of the Key Challenges of Non-Fungible Tokens," *Technological Forecasting and Social Change* (187), 1–13. <https://doi.org/10.1016/j.techfore.2022.122248>
- Ante, L. 2022. "Non-Fungible Token (NFT) Markets on the Ethereum Blockchain: Temporal Development, Cointegration and Interrelations," *Economics of Innovation and New Technology*. <https://doi.org/10.1080/10438599.2022.2119564>
- Anton, E., Oesterreich, T. D., Schuir, J., Protz, L., and Teuteberg, F. 2021. "A Business Model Taxonomy for Start-ups in the Electric Power Industry - The Electrifying Effect of Artificial Intelligence on Business Model Innovation," *International Journal of Innovation and Technology Management* (18:3), 1-54. <https://doi.org/10.1142/S0219877021500048>
- Bamakan, S. M. H., Nezhadsistani, N., Bodaghi, O., and Qu, Q. 2022. "Patents and Intellectual Property Assets as Non-Fungible Tokens; Key Technologies and Challenges," *Scientific Reports* (12:1). <https://doi.org/10.1038/s41598-022-05920-6>
- Bao, H., and Roubaud, D. 2022. "Non-Fungible Token: A Systematic Review and Research Agenda," *Journal of Risk and Financial Management* (15:5). <https://doi.org/10.3390/jrfm15050215>
- Beinke, J. H., Teuteberg, F., and Nguyen Ngoc, D. 2018. "Towards a Business Model Taxonomy of Startups in the Finance Sector Using Blockchain," *ICIS 2018 Proceedings*. <https://aisel.aisnet.org/icis2018/crypto/Presentations/9>
- Casale-Brunet, S., Zichichi, M., Hutchinson, L., Mattavelli, M., and Ferretti, S. 2022. "The Impact of NFT Profile Pictures within Social Network Communities," *ACM International Conference Proceeding Series*, 283–291. <https://doi.org/10.1145/3524458.3547230>
- Chalmers, D., Fisch, C., Matthews, R., Quinn, W., and Recker, J. 2022. "Beyond the Bubble: Will NFTs and Digital Proof of Ownership Empower Creative Industry Entrepreneurs?," *Journal of Business Venturing Insights* (17). <https://doi.org/10.1016/j.jbvi.2022.e00309>
- Chandra, Y. 2022. "Non-Fungible Token-Enabled Entrepreneurship: A Conceptual Framework," *Journal of Business Venturing Insights* (18). <https://doi.org/10.1016/j.jbvi.2022.e00323>
- Chang, B. 2022. *I ate at Bored and Hungry, the wildly hyped Bored Ape Yacht Club-themed fast food concept in California*, *Businessinsider*, May5. (<https://www.businessinsider.com/photos-i-dined-at-a-bored-and-hungry-nft-themed-fast-food-restaurant-2022-5>, accessed April 23, 2023)
- Chirtoaca, D., Ellul, J., and Azzopardi, G. 2020. "A Framework for Creating Deployable Smart Contracts for Non-Fungible Tokens on the Ethereum Blockchain," *Proceedings - 2020 IEEE International*

- Conference on Decentralized Applications and Infrastructures, DAPPS 2020*, 100–105. <https://doi.org/10.1109/DAPPS49028.2020.00012>
- Chohan, R., and Paschen, J. 2023. “NFT Marketing: How Marketers Can Use Nonfungible Tokens in Their Campaigns,” *Business Horizons* (66:1), 43–50. <https://doi.org/10.1016/j.bushor.2021.12.004>
- Chohan, U. W. 2021. “Non-Fungible Tokens: Blockchains, Scarcity, and Value.” <https://dx.doi.org/10.2139/ssrn.3822743>
- Colicev, A. 2023. “How Can Non-Fungible Tokens Bring Value to Brands,” *International Journal of Research in Marketing* (40:1). 30–37. <https://doi.org/10.1016/j.ijresmar.2022.07.003>
- Cornelius, K. 2021. “Betraying Blockchain: Accountability, Transparency and Document Standards for Non-fungible Tokens (NFTs),” *Information (Switzerland)* (12:9), 358. <https://doi.org/10.3390/info12090358>
- Dowling, M. 2022a. “Is Non-Fungible Token Pricing Driven by Cryptocurrencies?,” *Finance Research Letters* (44). <https://doi.org/10.1016/j.frl.2021.102097>
- Dowling, M. 2022b. “Fertile LAND: Pricing Non-Fungible Tokens,” *Finance Research Letters* (44). <https://doi.org/10.1016/j.frl.2021.102096>
- Eickhoff, M., Muntermann, J., and Weinrich, T. 2017. “What Do FinTechs Actually Do? A Taxonomy of FinTech Business Models,” *ICIS 2017 Proceedings*. <https://aisel.aisnet.org/icis2017/EBusiness/Presentations/22>
- Fairfield, J. A. T. 2022. “Tokenized: The Law of Non-Fungible Tokens and Unique Digital Property,” *Indiana Law Journal* (97). <https://ssrn.com/abstract=3821102>
- Flick, C. 2022. “A Critical Professional Ethical Analysis of Non-Fungible Tokens (NFTs),” *Journal of Responsible Technology* (12), p. 100054. <https://doi.org/10.1016/j.jrt.2022.100054>
- Glass, R. L., and Vessey, I. 1995. “Contemporary Application-Domain Taxonomies,” *IEEE Software* (12:4), 63–76. <https://doi.org/10.1109/52.391837>
- Guadamuz, A. 2021. “The Treachery of Images: Non-Fungible Tokens and Copyright,” *Journal of Intellectual Property Law and Practice* (16:12), 1367–1385. <https://dx.doi.org/10.2139/ssrn.3905452>
- Guidi, B., and Michienzi, A. 2022. “SocialFi,” *ACM SIGWEB Newsletter* (Summer), 1–8. <https://doi.org/10.1145/3545196.3545201>
- Hartwich, E., Ollig, P., Fridgen, G., and Rieger, A. 2023. “Probably Something: A Multi-Layer Taxonomy of Non-Fungible Tokens,” *Internet Research*. <https://doi.org/10.1108/INTR-08-2022-0666>
- Hofstetter, R., de Bellis, E., Brandes, L., Clegg, M., Lamberton, C., Reibstein, D., Rohlfen, F., Schmitt, B., and Zhang, J. Z. 2022. “Crypto-marketing: how non-fungible tokens (NFTs) challenge traditional marketing,” *Mark Lett* (33), 705–711. <https://doi.org/10.1007/s11002-022-09639-2>
- Horky, F., Rachel, C., and Fidrmuc, J. 2022. “Price Determinants of Non-Fungible Tokens in the Digital Art Market,” *Finance Research Letters* (48). <https://doi.org/10.1016/j.frl.2022.103007>
- Huang, Z. 1998. “Extensions to the k-Means Algorithm for Clustering Large Data Sets with Categorical Values,” *Data Mining and Knowledge Discovery* (2), 283–304. <https://doi.org/10.1023/A:1009769707641>
- Kim, J. 2021. “Advertising in the Metaverse: Research Agenda,” *Journal of Interactive Marketing* (21:3), 141–144. <https://doi.org/10.1080/15252019.2021.2001273>
- Kölbl, T., Joussen, K., and Weinhardt, C. 2023. “Between Hype, Hope, and Reality: A Lifecycle-Driven Perspective on Non-Fungible Token,” *ECIS 2023 Research Papers*. https://aisel.aisnet.org/ecis2023_rp/271
- Krumeich, J., Burkhart, T., Werth, D., and Loos, P. 2012. “Towards a Component-Based Description of Business Models: A State-of-the-Art Analysis,” *AMCIS 2012 Proceedings*. <https://aisel.aisnet.org/amcis2012/proceedings/EBusiness/19>
- Lee, E. 2021. “The Bored Ape Business Model: Decentralized Collaboration via Blockchain and NFTs,” *SSRN*. https://ssrn.com/abstract_id=3963881
- Li, S., and Chen, Y. 2022. “How Non-Fungible Tokens Empower Business Model Innovation,” *Business Horizons*. <https://doi.org/10.1016/j.bushor.2022.10.006>
- Lyubchenko, I. 2022. “What Is Art? NFTs, Bepple, and Art Connoisseurship in the 21st Century,” *Interactive Film & Media Journal* (2:3), 174–190. <https://doi.org/10.32920/ifmj.v2i3.1532>
- Mackenzie, S., and Bērziņa, D. 2022. “NFTs: Digital Things and Their Criminal Lives,” *Crime, Media, Culture* (18:4), 527–542. <https://doi.org/10.1177/17416590211039797>

- Martin, J., and Hay Kellar, C. 2021. "A Technical Deep Dive Into and Implementation of Non-Fungible Tokens in a Practical Setting". <https://timroughgarden.github.io/fob21/reports/r8.pdf>
- Massa, L., Tucci, C., and Afuah, A. 2017. "A Critical Assessment of Business Model Research," *Academy of Management Annals* (11:1), 73–104. <https://doi.org/10.5465/annals.2014.0072>
- Möller, F., Bauhaus, H., Hoffmann, C., Niess, C., and Otto, B. 2019. "Archetypes of Digital Business Models in Logistic Start-Ups," *ECIS 2019 Proceedings*. https://aisel.aisnet.org/ecis2019_rp/17/
- Möller, F., Stachon, M., Azkan, C., Schoormann, T., and Otto, B. 2022. "Designing Business Model Taxonomies – Synthesis and Guidance from Information Systems Research," *Electronic Markets* (32:2), 701–726. <https://doi.org/10.1007/s12525-021-00507-x>
- Murray, A., Kim, D., and Combs, J. 2023. "The promise of a decentralized internet: What is Web3 and how can firms prepare?," *Business Horizons* 66 (2), 191-202. <https://doi.org/10.1016/j.bushor.2022.06.002>
- Nickerson, R. C., Varshney, U., and Muntermann, J. 2013. "A Method for Taxonomy Development and Its Application in Information Systems," *European Journal of Information Systems* (22), 336–359. <https://doi.org/10.1057/ejis.2012.26>
- Onete, C. B., Năstase, I. A., Felea, M., and Dina, R. 2022. "The Potential of Non-Fungible Tokens (NFTs) in Higher Education as Perceived by Romanian Students," *8th BASIQ International Conference on New Trends in Sustainable Business and Consumption*. 804–811. <http://dx.doi.org/10.24818/BASIQ/2022/08/106>
- Osterwalder, A. 2004. "The Business Model Ontology - A Proposition in a Design Science Approach," PhD Thesis, PhD Thesis, Lausanne: University of Lausanne.
- Osterwalder, A., Pigneur, Y., and Tucci, C. L. 2005. "Clarifying Business Models: Origins, Present, and Future of the Concept," *Communications of the Association for Information Systems* (16). <https://doi.org/10.17705/1CAIS.01601>
- Osterwalder, A., and Pigneur, Y. 2010. *Business model generation - a handbook for visionaries, game changers, and challengers*, Wiley: Hoboken.
- Pateli, A. G., and Giaglis, G. M. 2004. "A Research Framework for Analysing E-Business Models," *European Journal of Information Systems*, 302–314. <http://dx.doi.org/10.1057/palgrave.ejis.3000513>
- Pinto-Gutiérrez, C., Gaitán, S., Jaramillo, D., and Velasquez, S. 2022. "The NFT Hype: What Draws Attention to Non-Fungible Tokens?," *Mathematics* (10:3), 335. <https://doi.org/10.3390/math10030335>
- Popescu, A.-D. 2021. "Non-Fungible Tokens (NFT)-Innovation beyond the Craze," *5th International Conference on Innovation in Business, Economics & Marketing Research*, 66. 26–30.
- Przybylski, A. K., Murayama, K., Dehaan, C. R., and Gladwell, V. 2013. "Motivational, Emotional, and Behavioral Correlates of Fear of Missing Out," *Computers in Human Behavior* (29:4), 1841–1848. <https://doi.org/10.1016/j.chb.2013.02.014>
- Punj, G., and Stewart, D. W. 1983, "Cluster Analysis in Marketing Research: Review and Suggestion for Application," *Journal of Marketing Research* (20:2), 134–148. <https://doi.org/10.2307/3151680>
- Regner, F., Schweizer, A., and Urbach, N. 2019. "NFTs in Practice-Non-Fungible Tokens as Core Component of a Blockchain-Based Event Ticketing Application," *ICIS 2019 Proceedings*. https://aisel.aisnet.org/icis2019/blockchain_fintech/blockchain_fintech/1
- Rehman, W., Hijab e Zainab, Imran, J., and Bawany, N. Z. 2021. "NFTS: Applications and Challenges," *2021 22nd International Arab Conference on Information Technology*. <https://doi.org/10.1109/ACIT53391.2021.9677260>
- Remane, G., Nickerson, R. C., Hanelt, A., and Bosch, J. T. 2016. "A Taxonomy of Carsharing Business Models," *ICIS 2016 Proceedings*. <https://aisel.aisnet.org/icis2016/Crowdsourcing/Presentations/18>
- Rousseeuw, P. J. 1987. Silhouettes: "A graphical aid to the interpretation and validation of cluster analysis," *Journal of Computational and Applied Mathematics* (20), 53–65. [https://doi.org/10.1016/0377-0427\(87\)90125-7](https://doi.org/10.1016/0377-0427(87)90125-7)
- Schaar, L., and Kampakis, S. 2022. "Non-Fungible Tokens as an Alternative Investment – Evidence from CryptoPunks," *The Journal of The British Blockchain Association* (5:1), 1–12. [https://doi.org/10.31585/jbba-5-1-\(2\)2022](https://doi.org/10.31585/jbba-5-1-(2)2022)

- Schoormann, T., Möller, F., and Szopinski, D. 2022. "Exploring Purposes of Using Taxonomies Exploring Purposes of Using Taxonomies," *Wirtschaftsinformatik 2022 Proceedings*. https://aisel.aisnet.org/wi2022/wi_interdisciplinary/wi_interdisciplinary/5
- Sharma, T., Zhou, Z., Huang, Y., and Wang, Y. 2022. "It's a Blessing and A Curse: Unpacking Creators' Practices with Non-Fungible Tokens (NFTs) and Their Communities," <https://doi.org/10.48550/arXiv.2201.13233>
- Staub, N., Haki, K., Aier, S., and Winter, R. 2021. "Taxonomy of Digital Platforms: A Business Model Perspective," *Proceedings of the Annual Hawaii International Conference on System Sciences* (Vol. 2020-January), 6163–6172. <https://doi.org/10.24251/HICSS.2021.744>
- Szopinski, D., Schoormann, T., John, T., Knackstedt, R., and Kundisch, D. 2017. "How Software Can Support Innovating Business Models: A Taxonomy of Functions of Business Model Development Tools," *AMCIS 2017 Proceedings*. <https://aisel.aisnet.org/amcis2017/eBusiness/Presentations/21>
- Szopinski, D., Schoormann, T., and Kundisch, D. 2019. "Because Your Taxonomy Is Worth It: Towards a Framework for Taxonomy Evaluation," *ECIS 2019 Proceedings*. https://aisel.aisnet.org/ecis2019_rp/104
- Tan, Y., Wu, Z., Liu, J., Wu, J., Zheng, Z., and Chen, T. 2023. "Bubble or Not: Measurements, Analyses, and Findings on the Ethereum ERC721 and ERC1155 Non-Fungible Token Ecosystem". <https://doi.org/10.48550/arXiv.2301.01991>
- Teece, D. J. 2010. "Business Models, Business Strategy and Innovation," *Long Range Planning* (43:2–3), 172–194. <https://doi.org/10.1016/j.lrp.2009.07.003>
- Timmers, P. 1998. "Business Models for Electronic Markets," *Electronic Markets* (8:2), 3–8.
- Tönnissen, S., Beinke, J. H., and Teuteberg, F. 2020. "Understanding Token-Based Ecosystems – a Taxonomy of Blockchain-Based Business Models of Start-Ups," *Electronic Markets* (30), 307-323. <https://doi.org/10.1007/s12525-020-00396-6>
- Veit, D., Clemons, E., Benlian, A., Buxmann, P., Hess, T., Kundisch, D., Leimeister, J. M., Loos, P., and Spann, M. 2014. "Business Models: An Information Systems Research Agenda," *Business and Information Systems Engineering* (6:1), 45–53. <https://aisel.aisnet.org/bise/vol6/iss1/8>
- Vom Brocke, J., Simons, A., Niehaves, B., Reimer, K., Plattfaut, R., and Clevén, A. 2009. "Reconstructing the Giant: On the Importance of Rigour in Documenting Literature Search Process," *ECIS 2009 Proceedings*. <https://aisel.aisnet.org/ecis2009/161>
- Wang, Qin, Li, R., Wang, Qi, and Chen, S. 2021. "Non-Fungible Token (NFT): Overview, Evaluation, Opportunities and Challenges," *ArXiv*. <https://doi.org/10.48550/arXiv.2105.07447>
- Ward, J. H. 1963. "Hierarchical grouping to optimize an objective function," *Journal of the American Statistical Association* (58), 236-244. <https://doi.org/10.2307/2282967>
- Webster, J., and Watson, R. T. 2002. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), xiii-xxiii. <https://www.jstor.org/stable/4132319>
- Weking, J., Mandalenakis, M., Hein, A., Hermes, S., Böhm, M., and Krcmar, H. 2020. "The Impact of Blockchain Technology on Business Models – a Taxonomy and Archetypal Patterns," *Electronics Markets* (30), 285–305. <https://doi.org/10.1007/s12525-019-00386-3>
- Wilson, K. B., Karg, A., and Ghaderi H. 2022. "Prospecting non-fungible tokens in the digital economy: Stakeholders and ecosystem, risk and opportunity," *Business Horizons* (65:5), 657–670. <https://doi.org/10.1016/j.bushor.2021.10.007>
- Wirtz, B. W., Pistoia, A., Ullrich, S., and Göttel, V. 2016. "Business Models: Origin, Development and Future Research Perspectives," *Long Range Planning* (49:1), 36–54. <https://doi.org/10.1016/j.lrp.2015.04.001>
- Yuan, C., and Yang, H. 2019. "Research on K-Value Selection Method of K-Means Clustering Algorithm," *J* (2:2), 226-235. <https://doi.org/10.3390/j2020016>
- Zaucha, T., and Agur, C. 2022. "Newly Minted: Non-Fungible Tokens and the Commodification of Fandom," *New Media and Society*. <https://doi.org/10.1177/14614448221080481>