Who's Buying NFTs in the Metaverse and Why? Identifying Influencing Factors and Segmenting Potential Buyers using Principal Component Analysis and K-means Clustering

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Abstract:

In recent years, the topic of metaverse has become increasingly present both in the broader society as well as in academia. Although there are a number of studies on the metaverse, there has been little attempt to understand why people buy NFTs in the metaverse. Therefore, this study aims firstly to find out the reasons why people buy NFTs in the metaverse, and secondly to identify possible buyer groups based on these factors. Our results show that there are six main factors that influence the purchase decision of NFTs in the metaverse, namely blockchain, design, popularity, community, utility, and rarity. Based on these factors, k-means clustering is used to form potential buyer groups. The resulting five clusters, namely Interested Stars, Design Lovers, Disregarders, Popularity Seekers, and Pragmatists, indicate a very diverse potential buyer group where the various factors vary in importance with respect to the decision-making process.

Keywords: Metaverse, NFT, customer segmentation

Track: Product and Brand Management

1. Introduction

"I believe the metaverse is the next chapter for the internet" (Zuckerberg/Meta, 2021). Marc Zuckerberg`s conviction is also shown in the rebranding of Facebook to Meta in 2021. Since then, the topic metaverse became more present in the broader society. An important technology for the metaverse is the blockchain. Part of this technology are non-fungible tokens (NFTs), which enable the ownership and trade of digital goods (Ethereum.org, n.d.; Hölzner & Blazickova, 2019). In 2021, the NFT market capitalization increased from USD 123.99 million to USD 16.89 billion from 2019 to 2021 (NonFungible Corporation, 2022). The most expensive NFT so far, Everydays: the first 5000 days, sold for USD 69.3 million (Crow & Ostroff, 2021). Furthermore, an increasing number of established companies from a wide range of industries are launching initial test trials to use NFTs and the metaverse (Adidas, 2022; Moy & Gadgil, 2022; Atari, 2022; Samsung, 2022). For example, Samsung opened its first Samsung 837X store in Decentraland in 2021, where visitors can earn limited NFTs (Samsung, 2022). As in the conventional business world, it is also important to correctly address the right target group in the metaverse. For this purpose, it is of interest to know potential NFT buyer groups in the metaverse. The research areas dealing with the topics of non-fungible tokens and the metaverse can still be described as young. The evolved market, the importance of customer segmentation for companies to target their audience, the importance of NFTs to the metaverse and the still limited research in these areas illustrate the need to create data-driven potential NFT buyer groups in the metaverse. Hence, this paper is concerned with the following research question: Which potential buyer groups of NFTs in the metaverse can be identified?

2. Theoretical background

2.1. Metaverse

There have been many attempts to define the term metaverse, but no agreed definition has yet been found (Lee et al., 2021; Smart et al., 2007; Kim, 2021). The metaverse could be defined "[…] as a virtual environment blending physical and digital, facilitated by the convergence between the Internet and Web technologies, and Extended Reality (XR)" (Lee et al., 2021).

2.2. Non-fungible-token (NFT)

Non-fungible tokens, NFTs, are unique, non-divisible tokens that are based on a blockchain, which can represent digital as well as physical assets. They can be related to a

wide variety of rights. As NFTs enable proof of ownership of digital assets, this enables them to be traded. In contrast to fungible tokens, NFTs are not 1:1 exchangeable due to their uniqueness (Ethereum.org, n.d.; Pinto-Gutiérrez, Gaitán, Jaramillo & Velasquez, 2022).

2.3. Evaluating NFTs in the metaverse

First, based on the literature, aspects were derived which are relevant for the evaluation of NFTs in the metaverse. Shi, Huo and Hou (2021) deal with the influence of aesthetics on the perceived value of a product. The results show that the aesthetics of a product have a significant influence on emotions. Products with high aesthetics evoke positive emotions (Shi, Huo & Hou, 2021). Products have a symbolic function through their aesthetics and enable their owners to express themselves to the outer world (Workmann & Caldwell, 2007) Furthermore the aesthetics of a product influence its perceived quality (Sternad & Mödritscher, 2018). In particular, for products whose quality is difficult to assess, extrinsic criteria's such as aesthetics are used for evaluation (Shi, Huo & Hou, 2021; Orth & De Marchi, 2007; Mumcu & Kimzan, 2015). Studies have also shown that a higher value is attached to limited products than to unlimited products. This is also reflected in a higher willingness to pay (Mittone & Savadori, 2009). Mekacher et al. (2022) show that rare NFTs are sold at higher prices. Studies have also shown that brands have an impact on consumers' willingness to pay and the economic value of a product (Crimmins, 2000; Schunk, Könecke & Preuß, 2017; Pappu, Quester & Cooksey, 2005; Ko et al., 2011). Brands have a social benefit, enable individuals to belong to and differentiate themselves from groups and facilitate self-realization and the expression of their own personality (Esch, Wicke & Rempel, 2005). Hernando and Campo (2017) have shown that the artist's name, which can be equated with a brand, influences the social value of a product. As in the real society, social interaction between people is also important in the metaverse (Cheng, Wu, Chen & Han, 2022). In social perception, NFTs play an important role in the metaverse, as through them the self can be expressed to the outside (Belk, 1988). An example would be the appearance of a person's avatar. Owning an NFT of a particular collection enables its owner to belong to a group associated with the collection. An example of this is the collection of the Bored Ape Yacht Club (BAYC). The BAYC is one of the most expensive and well-known NFT collections and a large number of celebrities own NFTs from this collection, which creates a high level of exclusivity. Purchasing an NFT from the collection thus enables the buyer to join this exclusive club (McNamara, 2022). This membership includes online communities, private chat rooms and events in the real world, among other things

(Kaczynski & Kominers, 2021). The Ownership of NFTs can be associated with a wide variety of rights. Property owners in The Sandbox, for example, can not only shape or sell their property, but also rent it out (The Sandbox, n.d.). A Genesis CyberKongz NFT, for example, generates $10BANANA per day for a period of 10 years. Among other things, $BANANAs can be used to vote in community decisions. Furthermore, they can be exchanged for various benefits such as name changes (Cyberkongz, n.d.a; Cyberkongz, n.d.b). The blockchain an NFT in the metaverse is created on is also important because it has an impact on aspects such as the transaction speed, security, transaction costs as well as the whole ecosystem that is associated with it (Avyan, 2021).

3. Methodology

To figure out factors influencing the evaluation of NFTs and in order to gain insight into potential NFT buyer groups, a two-stage research design is used. First, principal component analysis built upon the extensive literature review is conducted to identify influencing factors. Based on these factors, a k-means clustering using XLStat is performed to identify data-driven potential buyer groups (Almahri et al., 2019). Quantitative data was collected by means of a questionnaire. Participants were reached through non-probability sampling via e-mail and metaverse- and NFT-related social media channels. The questionnaire was available for participation from May to June 2022.

First, the qualification of the participants was tested by using knockout questions. For this purpose, it was asked if the participants are familiar with the topics NFT and metaverse. Then, based on the literature review, participants were asked 29 questions regarding potential influencing factors. A Likert scale with seven gradations was used. Only the two furthest attributes were labeled as "very strongly disagree" (1) and "very strongly agree" (7). Table 1 describes the composition of the sample in detail.

Table 1: Overview of participants (n=163)

18-24 years old	29.45 %	**female**	40.49 %
25-34 years old	58.28 %	**male**	57.67 %
35-44 years old	10.43 %	**non-binary**	0.61 %
45-54 years old	1.23 %	**prefer not do answer**	1.23 %
56-64 years old	0.61 %	**already bought NFTs (yes/no)**	29.45 % / 70.55 %
would describe himself/herself as technophile (M/SD)	5.50 /1.34	**already used metaverse platforms e.g. Decentraland or The Sandbox (yes/no)**	30.06 % / 69.94 %

4. Results

4.1. Principal component analysis (PCA)

PCA serves the purpose of reducing data while still retaining as much information as possible. This multivariate technique is used to break down the underlying structures of large sets of variables into a smaller number of factors (Field, 2013) To examine the suitability of the collected data for EFA, Kaiser-Mayer-Olkin (KMO) Test is performed. In this study KMO provides a value of .895, indicating that the sample is adequate to conduct a principal component analysis (Kaiser, 1974). Furthermore, a Cronbach Alpha value of .945 shows the scale reliability as well as the internal consistency of the survey instrument (Field, 2013). Varimax rotation is used to facilitate the interpretation of the results. This process results in six factors with eigenvalues greater than 1 as indicated by Kaiser (1974). Four variables were eliminated in this process as the factor loadings were below the threshold value of .4 or the variable loaded strongly on more than one factor resulting in a total of 25 variables divided among six factors which explain a total of 73.10% of the variance.

4.1.1. Factor 1 – Blockchain

The first factor represents 15.51% of the total variance and includes seven variables. This factor describes the importance of the blockchain ecosystem on which the NFT was created on, with all things related to it like interoperability, transaction costs and transaction speed. Furthermore, security aspects related to the blockchain used are also located in this factor.

4.1.2. Factor 2 – Design

Factor 2 accounts for 15.05% of the total variance and consists of five variables. The factor design is concerned with aspects such as aesthetics and identification with the design as well personal liking based on appearance. Design is also used here to assess visual quality of an NFT.

4.1.3. Factor 3 – Popularity

This factor represents 12.46% of the total variance and includes five variables concerned with popularity as well as publicity aspects. On the one hand, the popularity of the creator or brand that created it is included in this factor, on the other hand, the popularity as well as publicity of the NFT itself or the respective collection.

4.1.4. Factor 4 – Community

The factor community accounts for 11.37% of the total variance and includes three variables. This factor includes community-related aspects of the respective metaverse platform. Potential assistance and the answering of open questions is also important here.

4.1.5. Factor 5 – Utility

Utility represents 10.11% of the total variance and includes three variables concerned

with the utility associated with the respective NFT. Utility in this case refers to value-added benefits, such as voting rights or monetary rewards.

4.1.6. Factor 6 – Rarity

The last factor represents a total of 8.60% of the variance and also includes three variables which mainly relate to rarity and scarcity of an NFT or NFT collection.

4.2. K-Means Clustering

Based on the six factors derived from the EFA, k-means clustering is used in order to form clusters segmenting potential buyer groups amongst the survey participants following the approach of data-driven persona development described by Almahri et al. (2019). Clustering results differ based on the number of clusters to be formed. This number must be predefined in k-means (Almahri et al., 2019). For this purpose, the elbow method is proposed to estimate the number of clusters. The elbow method is a visual method that starts with K=2 clusters and increases K in increments of 1 until a plateau is reached (Kodinariya & Makwana, 2013; Syakur et al., 2018). In this study the plateau is reached after 5 clusters. Also, when looking at the iteration protocols for K=2 to K=8, convergence was achieved due to little or no change in cluster centers in 5 iterations at K=5, which was the lowest number of iterations among K=2 to K=8. Following table 2 shows the number of objects in each cluster, the within-class variance as well as the minimum, maximum and average distance to the respective centroids.

Table 2: Overview clusters with distanced to centroid (n=163)

Cluster	**1**	**2**	**3**	**4**	**5**
Objects	49	43	24	32	15
Within-class variance	4,334	6,945	11,772	6,451	5,934
Minimum distance to centroid	0,747	0,586	1,602	1,076	1,186
Average distance to centroid	1,969	2,380	3,150	2,381	2,268
Maximum distance to centroid	3,258	4,646	5,561	4,475	3,456

Table 3 illustrates the five clusters including naming, interpretation of content as well as the respective mean values of the six factors derived from EFA.

Table 3: Overview clusters with name, description and mean values

Cluster #	**Cluster Name**	**Description**	**Mean values**
1	Interested Stars	All factors are considered to be of high importance	Design: 5.61; Blockchain: 6.09; Popularity: 5.48; Community: 5.63; Utility: 5.51; Rarity: 6.03
2	Design Lovers	Design is very important, Community, Utility as well as Rarity apart from cluster 3 are least important	Design: 5.13; Blockchain: 4.74; Popularity: 3.98; Community: 3.52; Utility: 4.16; Rarity: 4.56
3	Disregarders	All factors are considered to be of low importance	Design: 2.53; Blockchain: 3.47; Popularity: 2.53; Community: 2.58; Utility: 2.94; Rarity: 2.07
4	Popularity Seeker	Popularity and Utility are considered to be very important, design and rarity considered less important	Design: 4.13; Blockchain: 5.65; Popularity: 5.47; Community: 5.36; Utility: 5.78; Rarity: 4.30
5	Pragmatists	Design not important at all, but Utility and rarity is crucial	Design: 2.47; Blockchain: 5.26; Popularity: 3.85; Community: 4.80; Utility: 5.89; Rarity: 5.96

In figure 1 the mean values of the 5 clusters for each factor are plotted on a line chart for better visualization.

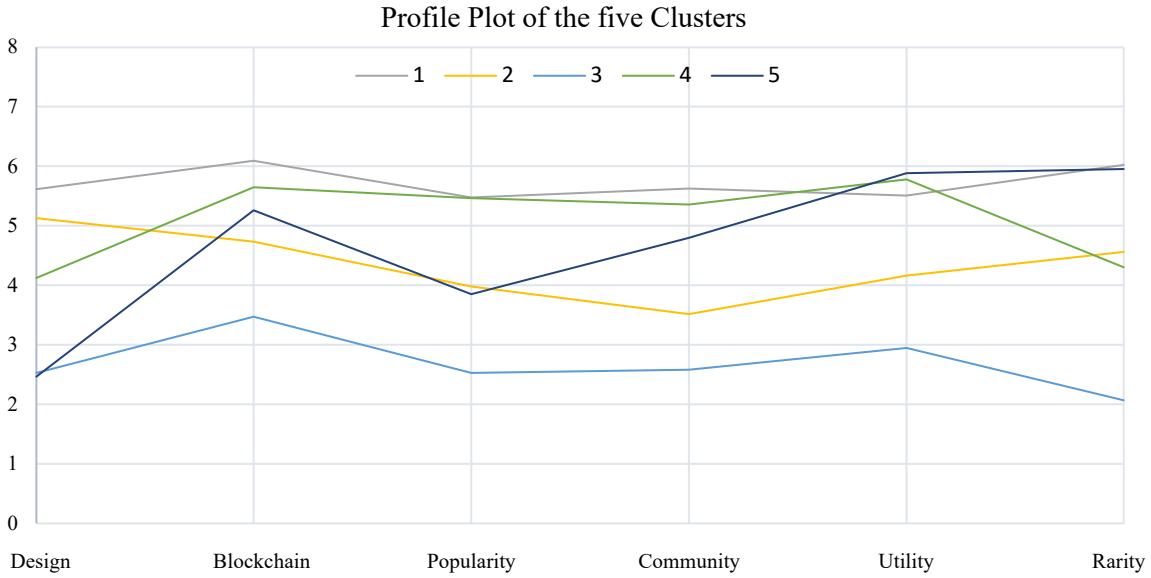

Figure 1: Profile Plot of the five clusters

To find out whether there are significant differences between the individual clusters per individual factor, an ANOVA with subsequent Bonferroni-corrected post hoc test is performed. Table 3 illustrates the results of the ANOVA, followed by a more detailed discussion of differences in the pairwise comparisons per cluster in the accompanying text.

Table 4: ANOVA test statistics with F-value, p-value and Eta^2

Observation	F	Pr > F	Eta^2
Blockchain	34,010	< 0,001	0.463
Design	56,846	< 0,001	0.590
Popularity	46,074	< 0,001	0.538
Community	44,858	< 0,001	0.532
Utility	26,185	< 0,001	0.399
Rarity	85,997	< 0,001	0.685

4.2.1. Cluster 1 – Interested Stars

For cluster 1, all of the six factors are assigned a very high importance. The mean values of the respective factors, with the exception of the utility factor, are highest in this cluster. Using ANOVA, significant differences to other clusters were found. However, using Bonferroni-corrected post hoc tests, the differences to the next higher cluster are not significant for each factor.

4.2.2. Cluster 2 – Design Lover

Cluster 2 assigns the greatest importance to design, apart from cluster 1. Significant differences in the factor design compared to the next highest cluster 4 can be identified (MDiff = 1.00, $p < 0.001$). The community as well as the utility aspect are apart from cluster 3 lower than all other clusters. Comparing the factor community with the next highest cluster 5, this factor is attributed

significantly lower importance (MDiff = 1.28, p = 0.002). Also, when comparing the factor utility with the next highest cluster 1, utility is attributed significantly lower importance as well (MDiff = 1.35, p < 0.001).

4.2.3. Cluster 3 – Disregarders

For cluster 3, all of the six factors are assigned relatively low importance. The mean values of the respective factors, with the exception of the design factor, are lowest in this cluster. Differences to the next highest cluster are significant in each case (Blockchain compared to cluster 2: MDiff = 1.27, p < 0.001; Popularity compared to cluster 5: MDiff = 1.32, p = 0.001; Community compared to cluster 2: MDiff = 0.94, p = 0.011; Utility compared to cluster 2: MDiff = 1.22, p = 0.003; Rarity compared to cluster 4: MDiff = 2.23, p < 0.001) apart from factor design.

4.2.4. Cluster 4 – Popularity Seeker

Cluster 4 assigns the greatest importance to popularity, apart from cluster 1. Significant differences in the factor popularity compared to the next highest cluster 2 are present (MDiff = 1.49, p < 0.001). Less importance is attributed by this cluster to the factors design as well as rarity.

4.2.5. Cluster 5 – Pragmatists

When looking at the Mean values, Cluster 5 assigns the highest importance to utility among all clusters. Significant differences in the factor design compared cluster 4 (MDiff = 1.66, p < 0.001) and in the factor popularity compared to cluster 2 (MDiff = 1.40, p < 0.001) can be identified. The popularity aspect is, apart from cluster 3, least pronounced in this cluster.

5. Discussion

Cluster analysis yielded five distinct clusters to segment potential buyer groups based on the six in chapter 4.1. derived factors from the PCA. In Cluster 1, the Interested Stars, each of the factors, namely design, blockchain, popularity, community, utility, and rarity, is assigned a high importance. Here, it can be hypothesized that these individuals are more so intensively researching the NFT and are preparing for all possible eventualities prior to making a decision. Although the design is ranked as least important across all groups when looking solely at the means, in cluster 2, the Design Lover, this is the most important criterion for evaluating NFTs. This goes in line with the findings of Shi, Huo & Hou (2021), Orth & De Marchi (2007) and Workmann & Caldwell (2007) that aesthetics play a big role in evaluating products, in this case NFTs, especially in a symbolic way to identify and express themselves to the outer world. Cluster 3, the Disregarders, attribute the least importance to all factors except design. This does not necessarily mean that they are not interested in NFTs in the metaverse, but they are less concerned with the influencing factors than the other clusters. Therefore, it can be hypothesized that they make their decision more so according to their gut feelings than on any of the six factors. In cluster 4, the Popularity Seeker, four factors are particularly important for decision-making, namely blockchain, popularity, community and utility. Especially the factor popularity, which includes the popularity of the NFT itself but also the popularity of the brand that created it, is assigned significantly higher importance

when compared to the next higher cluster. This goes in line with the findings of Hernando and Campo (2017). The factors design and rarity of the respective NFTs in the metaverse, on the other hand, are assigned a lower importance. For the final cluster 5, the Pragmatists, utility is the most important factor for evaluating NFTs. Utility in this context describes an additional benefit such as monetary rewards or voting rights. In addition, the factor rarity is considered significantly more important, apart from cluster 1, than in all of the other clusters, similar with the findings of Mittone & Savadori (2009) regarding physical products. The design, on the other hand, is assigned the significantly lowest importance apart from cluster 3, therefore this cluster is referred to as the Pragmatists.

6. Conclusion

In conclusion, it should be pointed out that NFTs in the metaverse and the underlying motives for buying them are still under-researched. This study therefore attempts to identify influencing factors and to provide an initial overview of potential buyer groups. The five clusters derived from the k-means clustering indicate a very diverse potential group of buyers, where different factors are attributed a high degree of importance with regard to the decision-making process. For an initial classification, this study was able to filter out six influencing factors (Blockchain, Design, Popularity, Community, Utility and Rarity) that are pronounced to different degrees in the five clusters, namely Interested Stars, Design Lovers, Disregarders, Popularity Seeker and Pragmatists. However, there were some limitations in this study. Although the literature review attempted to cover all possible influencing factors, it cannot be ensured that the final set of 25 variables used in this study covers all possible influencing factors. Nor can it be said with certainty that if the respective criteria are fulfilled to a high degree by NFT creators, that the potential buyer groups will actually respond to them. In a further study, an experimental design could be used to test whether the fulfillment of the 6 factors, tailored to the respective buyer groups, actually leads to the desired change in behavior, in this case the purchase of the respective NFT in the metaverse.

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