

Assessing engagement decisions in NFT Metaverse based on the Theory of Planned Behavior (TPB)

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ABSTRACT

Non-Fungible Tokens (NFTs) have reached enormous levels of interest all over the world; The attraction was huge besides buying or creating an NFT. However, the actual use requires consideration of many aspects and sources to make decisions and engage in the NFT market. Moving forward and selecting what to create or where to buy, it is necessary to assess the NFT and whether it is worth investing in or not. On the other hand, Metaverse has become a trending topic and market interest has increased dramatically. However, NFT is crucial to enable the Metaverse; NFT approved its essential to the success of Metaverse adoption. In conclusion, this choice is complicated, especially when it involves extensive knowledge and information from different sources and perspectives (Engineering and Social Science). Some aspects are related to the customer experience and trust, and others are more likely to be asset-related. As we look at the blockchain market, we distinguish a variety of platforms and applications that can be used conveniently, presenting numerous options and possibilities. That brings to mind some ideas and asks some questions to assist the engagement in the NFT metaverse; When is the best moment to engage in the NFT metaverse? Is trading or engaging in the NFT metaverse trustworthy? Is it legal to use and trade NFTs, is there any need for governments to get involved? What NFT piece should create or what price to buy? What is the best and most secure platform to use? Assessing the NFTs requires deep research into different sources of controversial information and data. However, no such reference or study covers these considerations in detail; the lack of trusted resources and knowledge impacts the user experience and engagement. This paper contributes to social science studies by performing a multi-factor (comprehensive) analysis that includes the NFT Metaverse engagement decision and user behavior. We are using an extended model of the theory of planned behavior (TPB), proposing a model which includes external factors to help identify the variables that influence the engagement with NFTs in the metaverse. This comprehensive study has a multi-perspective approach; customer perspective, social perspective, technology perspective, legal perspective, and market perspective. We present extensive knowledge and information to be a helpful piece of awareness for everyone who intends to buy, invest, or create an NFT. This study uses a quantitative analysis method and provides meaningful results explaining this dilemma and the reasons behind the massive adoption of NFT and its fluctuation worldwide. This work helps the decision-makers, creators, and investors consider new development perspectives in the NFT metaverse. The methodology used primary survey data and analyzed with Smart-PLS 4 to determine variance-based structural equation modeling (SEM) using the partial least squares path modeling (PLS) method.

1. Introduction

For more than ten years, the innovation of blockchain technology began to be recognized with Bitcoin [66], and since then, the development of this technology has not stopped and keep growing. In 2014, a new generation of blockchain was released when Vitalik Buterin opened the Ethereum platform and was amazed by the smart contract, which allows the writing and execution of programming codes as an electronic

law [16]. More innovative services were integrated and launched on new platforms which start to show advanced levels of assistance and services. In Ethereum, there are two primary standards ERC-20 (Fungible token) and ERC-721/ERC-1155 (non-fungible token); Both standards vary significantly in utilization purposes, ERC-20 for tokenization which can be used as a digital currency or any other fungible token. However, ERC-721/ERC-1155 it's mainly for collectibles, goods, and artwork (unique pieces). The creation of NFT leads to a variety of use cases that

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were lack to be implemented with the fungible token (ERC-20). ERC-721 standard opens up opportunities for the blockchain technology market by offering a non-fungible token (NFT) with a wide range of innovations, which cannot be exchanged in a like-for-like approach [11]. To enable interoperability and support inside the Ethereum platform, the community agreed on multiple application-level standards called Ethereum Requests for Comments (ERCs) [75]. ERC-721 describes each NFT as a decentralized application, which has a unique specification; it can be generalized as follows [28]:

- Verifiability: Each NFT token can be publicly verified the ownership within the blockchain network.
- Transparent Execution: All transaction activities are publicly confirmed, and everyone within the network can see them.
- Availability: One of the blockchain features is that the system never shut down or stopped; it is available to perform transactions 24hr/day.
- Tamper-resistance-storage: It will never be changed when an NFT transaction is confirmed and stored inside the blockchain ledger.
- Usability: NFT smart contract stores all the metadata and the history of the ownership, with all needed information.
- Uniqueness: Each NFT has to create a smart contract and metadata integrated to form a unique and universally identifiable digital asset stored permanently on a blockchain network.
- Tradability: Every NFT can be minted, sold, and purchased publicly.

In 2017, CryptoKitties started the first NFT project using ERC-721, which make more than \$1.3 million worth of transactions on the first day of opening [30,82]. Since then, the market has continued to rise, and new platforms ready to use like Solana [96], Binance [98], and KATAN [50] have started setting their NFT standards to compete globally. In 2022, the number of NFT transactions in Ethereum only reached more than 87 million transactions [29], which puts NFT at the forefront of blockchain technologies [52] performed a comparative study of monthly market investment; The results show that NFT has a (16.99%) ROI in time ETH has only (5.02%) ROI; Also, NFT has 13 times (58.77%) ROI higher than stock returns [52]. The market shows that early investors obtain thousandfold returns by trading digital collectibles; in 2020, the NFTs market engagement increased significantly, and the massive user attraction [93]. Recently the NFT has become a core part of a virtual world called the metaverse that combines visualizations and a sense of reality [65,88]. The Metaverse is tremendous innovation that has become a hot topic showing an entirely new virtual world. It is a virtual integration of multi technologies such as AI, IoT, and Blockchain [36].

However, we found an abnormal sign showing a massive decline in the NFT market within the last few months; On August 29, 2021, the number of NFT deals reached 175 thousand transactions with about 411 million dollars in volume; it declined on April 19, 2022, to 24 thousand transactions and 42 million dollars of the trading volume [68]. This market volatility shows unpredicted changes, and there are no clear indications as to why the NFT market is down. Meanwhile, there is no such academic research or investigation exploring the relationship between users and NFT metaverse; statistics lack resources and explanations.

This paper aims to examine, anticipate and quantify the factors that influence users' decision to engage in the NFT metaverse using an extended model of the theory of planned behavior (TPB). Five new constructs will be added to TPB; Trust impact, Regulatory, Social, Technical, and Market. The Metaverse is a multi-user digital environment that uses augmented reality with virtual reality, a post-reality universe. The concept is based on the convergence of technologies that enable flexible interaction between people, digital objects, and virtual environments [65]. As a result, blockchain-based technologies such as NFT may be viable support to the metaverse due to decentralization, immutability, and transparency [36]. Blockchain and NFT should be the primary back-end technology for enabling metaverse usage and security [88].

Furthermore, this research will be answering important questions: When is the best moment to engage in the NFT metaverse? Is trading or

engaging in the NFT metaverse trustworthy? Is it legal to use and trade NFTs, is there any need for governments to get involved? What NFT piece should create or what price to buy? What is the best and most secure platform to use?

Blockchain technology and NFT are future innovations aimed at the Decentralized Autonomous Organization (DAO). The need for academic research in this field is growing, which is the impetus to explore all the effects and causes of technology adoption and participation. This paper aims to provide the missing knowledge and experience to support academic studies and open the door for further research.

2. Organization of this paper

This paper is organized as follows. Section 3 defines the theory of planned behavior (TPB). Section 4 introduces the research hypotheses and the model development. Section 5 shows the research methodology. Section 6 represents the research analysis results. Section 7 presents the research discussion and implications. Section 8 performs the conclusion. Section 9 shows the limitations and future research.

3. The Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) [2] is an extended version of the Theory of Reasoned Action (TRA) [33]. For decades TPB served as the primary guidance for research on human actions [3]. It is the most influential theory for understanding the user decision and assists in cracking the research on human behavior [4]. The theory divides human behavior into behavioral beliefs, normative beliefs, and control beliefs [3]. The theory has five constructs; Attitudes toward Behaviors, Subjective Norm, Perceived Behavioral Control, Intention, and Behavior [2].

Fig. 1 below shows the theory of planned behavior and all the relationships between the constructs.

Ajzen justified the definition of each construct to fit the purpose of evaluating and assisting the behavior toward important decisions; Attitude toward behavior describe an individual's positive or negative evaluation of self-performance of the particular behavior; Subjective norm show the belief of whether most people approve or disapprove of the behavior; Perceived behavioral control measures an individual's perceived ease or difficulty in performing a particular behavior; The intention is a person's intent or motivation to do some acts. Behavior determines the ability to perform a particular behavior, and that help to decide what you want to do or not do [2].

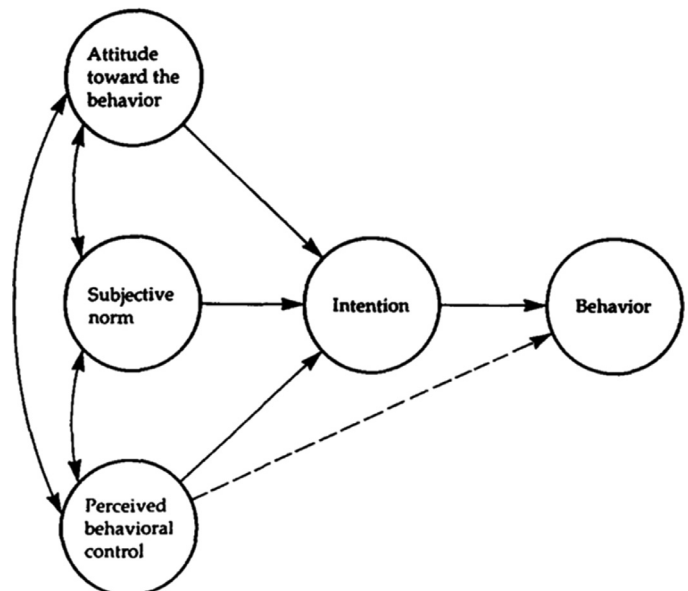


Fig. 1. The theory of planned behavior [2].

Several features of TPB explain its widespread use as a model for predicting and changing behavior. It focuses directly on the determinants of behavior; unlike other social and behavioral sciences theories, it can be applied to any behavior of interest to the investigator [1]. The TPB is accompanied by a set of well-established methodological tools that can be used to obtain reliable and valid measures of its theoretical constructs. A clearly defined structural model is underpinned in the TPB. The framework provides a conceptual model for thinking about the determinants of human behavior that can be applied to empirical tests using multiple regressions and structural equation modeling. In addition, the theory has been supported by many experimental studies and it is suitable for technology prediction [5].

4. Hypotheses and model development

The theory of planned behavior (TPB) is a well-established framework for predicting user behavior toward a critical decision [3]. It has been used in further research and helped develop and predict specific decisions not only in the health sector but used in other fields as technology use [37,45,84]. As mentioned earlier, due to the particular characteristic of NFT and to gain a comprehensive understanding of the use of NFT in the metaverse. This study conducted a survey scanning for published articles and reports and perform a mapping to get the most influential factors in NFT and Metaverse. As a summary of this mapping, we added five new constructs (Trust impact, Regulatory impact, Social impact, Technical impact, and Market impact) to aid the engagement decision shown in the proposed model Fig. 2:

4.1. TPB-core constructs

4.1.1. Behavior (B)

Behavior is the human ability or capability to perform an action, it could be a positive or negative behavior [3]. Behavior is a mixture of

an individual's attitude toward completing a given behavior and beliefs about what others expect him to do in that situation. In turn, normative beliefs are multiplied by how motivated an individual is to comply with the norms [7]. The behavior of interest in relation to target, action, context, and time frame, all can be defined at different levels of generality or specificity [5]. The person's behavior is more related to his/her feeling of moral obligation [84]. Behavior controls perception and vulnerability; It is the actual choice of activating an action that is influenced by both internal and external factors [31,73]. Behavior refers to the ability of a user's subjective causes to perform a behavior on the service [32].

4.1.2. Intention (I)

The intention represents people's stated motivation and their action plan or decision-making [34]. To predict the most obvious behavior, we often begin to predict intentions [54]. Prespecified intentions may be moderated by respondents' general needs to act on various actions [95]. Many researchers and studies are interested in the importance of the assumption of equivalence between intentions and behavior, including the theory of reasoned action (TRA) [34,83], the theory of planned behavior (TPB) [2], and the technology acceptance model (TAM) [23]. A particular focus of these studies has been on factors that may influence the relationship between intentions and behavior [80]. It has been approved among hundreds of studies that intention significantly influences behavior [9,10]. A person's intention results from his attitude to performing a behavior and subjective norm. One action can be predicted from the attitude to that action, providing a significant correlation between the intention and the behavior [8]. Hence, it is hypothesized that:

H1: The Intention has a positive and significant impact on Behavior toward the engagement decision in the NFT Metaverse.

4.1.3. Attitudes toward Behaviors (A)

An attitude is an emotion, belief, or behavior toward a particular thing, person, or event. Situations often result from experiences or up-

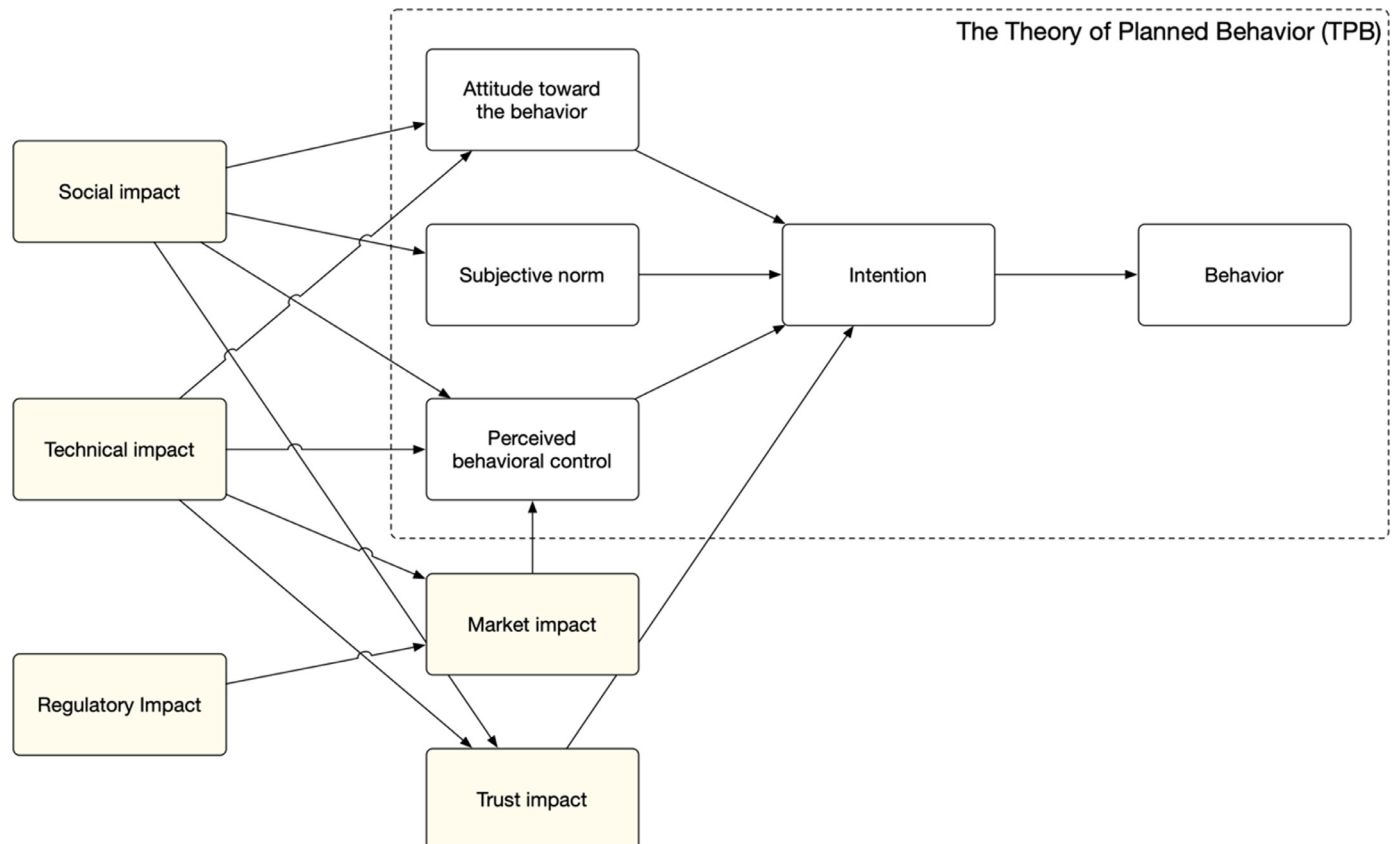


Fig. 2. The proposed model.

bringing and can strongly influence behavior. However, attitudes can change as well, depending on external influences [6,76]. A person's attitude towards a particular action is suggested by the perceived results of the action and their values for the individual [7]. Glassman found that attitudes most heavily influenced intentions; there is a strong correlation between the two constructs [95]. Svenning found that referent group attitudes slightly influenced attitudes toward a proposed video-conferencing system [89]. The impact of attitude on future IS use was at best modest according to Davis [24]. Hence, it is hypothesized that:

H2: The Attitude toward the behavior has a positive and significant impact on Intention toward the engagement decision in the NFT Metaverse.

4.1.4. Subjective norm (SN)

In psychology, subjective norm refers to the external pressure felt by individuals to perform or not perform certain behaviors [2]. A target person's subjective norm is their opinions about how other people who are important to them should behave [92]. Subjective norms significantly impact intention, and it shows a massive impact on buyer decisions [90]. Multiple correlations between subjects and within subjects were effective in predicting behavioral intentions based on attitudes and subjective norm [92]. In a study on job satisfaction the authors found that the level of satisfaction was higher when subjective norm were high; which meant the subject norms has a direct impact on intentions [53]. Hence, it is hypothesized that:

H3: The Subjective norm has a positive and significant impact on Intention toward the engagement decision in the NFT Metaverse.

4.1.5. Perceived behavioral control (PBC)

Perceived behavioral control is derived by adding the strength and power of belief and the resulting products' accessible control factors. It can measure how much the intention of doing this act could make the goal more accessible or more difficult [2-4]. It refers to the best use of the system or service by balancing the human capabilities like skills, resources, and opportunities required [60]. Behavioral control is attributed to beliefs regarding the availability of resources and opportunities necessary to facilitate desired behavior [5]. This is a concept that deals with consumer perceptions about whether a behavior is under their control. Perceived behavioral control is the consumer's perception of control over a potential act based on facilitating factors that enable it; since the consumer has the resources to manage behavioral activities, it may facilitate information acquisition and deal with or encourage such behavior [70]. Hence, it is hypothesized that:

H4: The Perceived behavioral control has a positive and significant impact on Intention toward the engagement decision in the NFT Metaverse.

4.2. External constructs

4.2.1. Market impact (M)

Market impact refers to market stability, competitiveness, and future expectations; it can describe how the technology market can impact individual performance and decisions. Market stability and reputation are essential for customers; more trust is gained by enhancing the relationship between users and the market [13,14,71]. One research was conducted in marketing studies highlighting that market behavior was not considered an essential factor or missed from the market consideration, which twists the customer behavior and intentions toward services [77]. On other hand, future market expectations may show that decision-makers focus on leading more than enhancing service quality and competing with their competitors, showing a lack of social interactions and loyalty [55,77,86]. Different studies find that market changes strongly impact user intentions; for example, in India, the commercial bank starts to support customers by moving to support the free market

and technology development approach [18,56]. Understanding the connection between the market or/and business with the customers in terms of a B2C relationship provides a broader picture of the expectations and needs; it is crucial to strengthen such a connection to enhance loyalty. Firm-market relationships are experiencing radical changes due to the complexity of customers' needs, which appear with increased frequency as groups of social interactions impact behavior [18]. A customer's experience determines the belief level in the e-market; the market characteristics like usability and security play an essential role in the customer's intentions [49]. Hence, it is hypothesized that:

H5: The Market has a positive and significant impact on Perceived behavioral control toward the behavior toward the engagement decision in the NFT Metaverse.

4.2.2. Trust impact (T)

Trust is the expression of confidence between people and technology or electronic service; how much the user can trust technology. The amount of trust shown by the user's level of comfort, confidence, and security when using technology [46,61]. Decision support systems should include the concept of trust; No matter how the service is developed, it may be rejected by the distrustful decision-maker and lose the benefits [64]. Furthermore, trust becomes more considerable when the technology develops and usage intention increases [74]. An interesting study on gene development mentioned that the belief in gene technology rules and social trust together in scientific research is essential to realize the technology is acceptable and safe; social trust can support confidence in the technology [85]. People usually trust technology or service when it has a high level of security and design quality; still, it is not effortless how to control and build this trust [74]. Talking about the importance of service quality, Roy and Dewit find that service quality and design have a remarkable influence on the service trust, impacting the user intention [79]. Trust in the seller (service provider) impacts the intentions which are determined by external factors like reputation, quality, and general structure [62]. Hence, it is hypothesized that:

H6: The Trust has a positive and significant impact on Intention toward the engagement decision in the NFT Metaverse.

4.2.3. Social impact (S)

The social impact points out the effect on an individual's perception of people they believe in or trust; this kind of impact guides the person to behave differently toward the use of technologies [9,20]. Reports or studies from technology experts might be a base to review and take advice for people who cannot assess confidence, risks, or benefits [85]. Social interaction between people using technologies facilitates actions and determines how communication technology is used and contributes to life goals [35]. Malhotra and Galeta, in 1999, conducted a sociological study on e-commerce systems; They found that even when on-campus libraries are cheaper and more efficient than using online applications, a user is more likely to engage in social contact physically; These forces strongly influence users' attitudes and behavior toward the deployment of new technologies [58]. Social impact consists of informative reality and normative experience; in general, people have accepted technologies and believe them according to information from their trusted friends, relatives, and coworkers [26]. Attitudes, behavior, and intentions were significantly influenced by social influences, such as perceptions of critical mass and norms [44]. According to the theory of Social exchange, if people behave as the social norms advised, the expected benefits will show much higher trust, income, and gratitude [15]. Hence, it is hypothesized that:

H7: The Trust has a positive and significant impact on Attitude toward the behavior toward the engagement decision in the NFT Metaverse.

H8: The Trust has a positive and significant impact on Subjective norm toward the engagement decision in the NFT Metaverse.

H9: The Trust has a positive and significant impact on Perceived behavioral control towered the engagement decision in the NFT Metaverse.

H10: The Trust has a positive and significant impact on Trust towered the engagement decision in the NFT Metaverse.

4.2.4. Technical impact (T)

Technical impact represents the technical features that influence service quality and delivery and impact users' attitudes and intentions, such as interactivity, interoperability, and stability. [12]. Lin, Yan, and Chen researched some technical features of online commerce and discovered its substantial impacts on the users' trust [57]. Through interaction with the possible technological features, online customers create their own opinions and trust in the social commerce market [69]. A model was presented in 2008 by Markus and Silver, showing the impact of the technical objectives on the users' intentions; this study intends to describe a technical specification and test them on users [59]. A similar study was contacted later for online shopping evaluating the interactions between users and the online market [38]. Both studies find that various features have a separate impact on users' intentions and experiences. A significant portion of users' repurchase intent is by predicting the technical features of social commerce websites, such as recommended testing the effects of different subtypes of technology on service quality [57]. A study on virtual purchasing finds that the technological aspect (interactivity and sociability) and spatial aspect (density and stability) are strongly impacting the experience of the virtual world which affects the intention to use [12]. In Adaptive Structuration Theory (AST), two perspectives are considered the technology structure and people's intention/interaction to advance and understand the information technology usage inside an organization or services [25]. User interaction with website technical features is an essential aspect of e-commerce interactivity. Designing and planning the technical features provides the best context and structure for the best services, such as the color or shape of toolbar icons or labels, which should be considered in technical objectives [59]. The consumer interacts with websites filtering out information to obtain relevant product details before committing to an online purchase [47,97]. From a customer's perspective, the technical features are essential, and they should be clarified and simple to enhance the experience and impact the intention. Hence, it is hypothesized that:

H11: The Technology has a positive and significant impact on Attitude toward the behavior towered the engagement decision in the NFT Metaverse.

H12: The Technology has a positive and significant impact on Perceived behavioral control towered the engagement decision in the NFT Metaverse.

H13: The Technology has a positive and significant impact on Market towered the engagement decision in the NFT Metaverse.

H14: The Technology has a positive and significant impact on Trust towered the engagement decision in the NFT Metaverse.

4.2.5. Regulatory impact (R)

Regulatory impact concerns the legal systems that are established by the authorities to monitor technologies and assure that service providers and consumers meet their commitments and avoid fraud [67]. Government regulations and laws are strongly impacting the customer attitude toward marketing [9,14]. Researchers Barksdale, Darden, and William find that news reports of government efforts to ensure the integrity of promotion games (contests) may explain the positive change in social interaction and users' attitudes toward a specific service [63]. In a respected study on customer attitude, most people responded and agreed that there should be additional government regulation protecting the customers [14]. Regarding the crypto market, Chang finds that the low level of trust in the cryptocurrency market forces governments worldwide to issue financial regulations aimed at protecting investors and regular users and enhancing usability [19]. Legitimate and secure cryptocurrency relations can only be established through progressive jurisdictional and state regulation of cryptocurrency activity and other blockchain financial applications to monitor market activities [22]. Authorities should identify the importance of legislative regulation and the main factors affecting movement within the legal sphere. Legal code needs to reduce risk as its primary objective regarding market engagement [72]. To ensure the safe usage of innovations under blockchain technology, governments incorporated with International organizations to enforce multi policies and regulations on the use of blockchain technologies such as Know Your Customer (KYC) and Anti-Money Laundering (AML) [42]. However, these regulations need to be updated and revised each time is required; blockchain technology is still in the early stage of implementation, and many new services are updated [87]. Hence, it is hypothesized that:

H15: The Regulatory has a positive and significant impact on Market toward the engagement decision in the NFT Metaverse.

4.3. Definitions of constructs

The table below (Table 1) shows the constructs definition and core meaning, which express our study intentions:

5. Research methodology

This research uses structural equation modeling (SEM) to design the model and construct relationships, as shown in Fig. 2. Validated factors

Table 1
Definitions of constructs.

Construct	Operational definition	Refs.
Behavioral (B)	The human ability or capability to perform an action could be a positive or negative behavior	[3]
Intention (I)	People's stated motivation and their action plan and decision making	[34]
Attitudes toward Behaviors (A)	The emotion, belief, or behavior toward a particular thing, person, or event. Situations often result from experiences or upbringing and can strongly influence behavior and change it	[6,76]
Subjective Norm (SN)	The external pressure felt by individuals to perform or not perform certain behaviors	[2]
Perceived Behavioral Control (PBC)	The strength and power of faith lead to control over which products can be accessed. It measures the extent doing this action makes the goal more accessible or more difficult	[2–4]
Market impact (M)	Market impact refers to the market stability, competitiveness, and future expectations; it can describe how the technology market can impact individual performance and decisions	[14]
Trust impact (T)	The expression of confidence between people and technology; how much the user can trust technology. Trust can be shown by the user's level of comfort, confidence, and security when using technology	[46,61]
Social impact (S)	The effect on an individual's perception of people they believe in or trust; this impact guides the person to behave differently toward using technologies	[9,20]
Technical impact (TCH)	Technical impact represents the technical features that influence service quality and delivery and impact users' attitudes and intentions, such as interactivity, interoperability, and stability	[12]
Regulatory impact (R)	The legal systems that are established by the authorities to monitor technologies and assure that service providers and consumers meet their commitments and avoid fraud	[67]

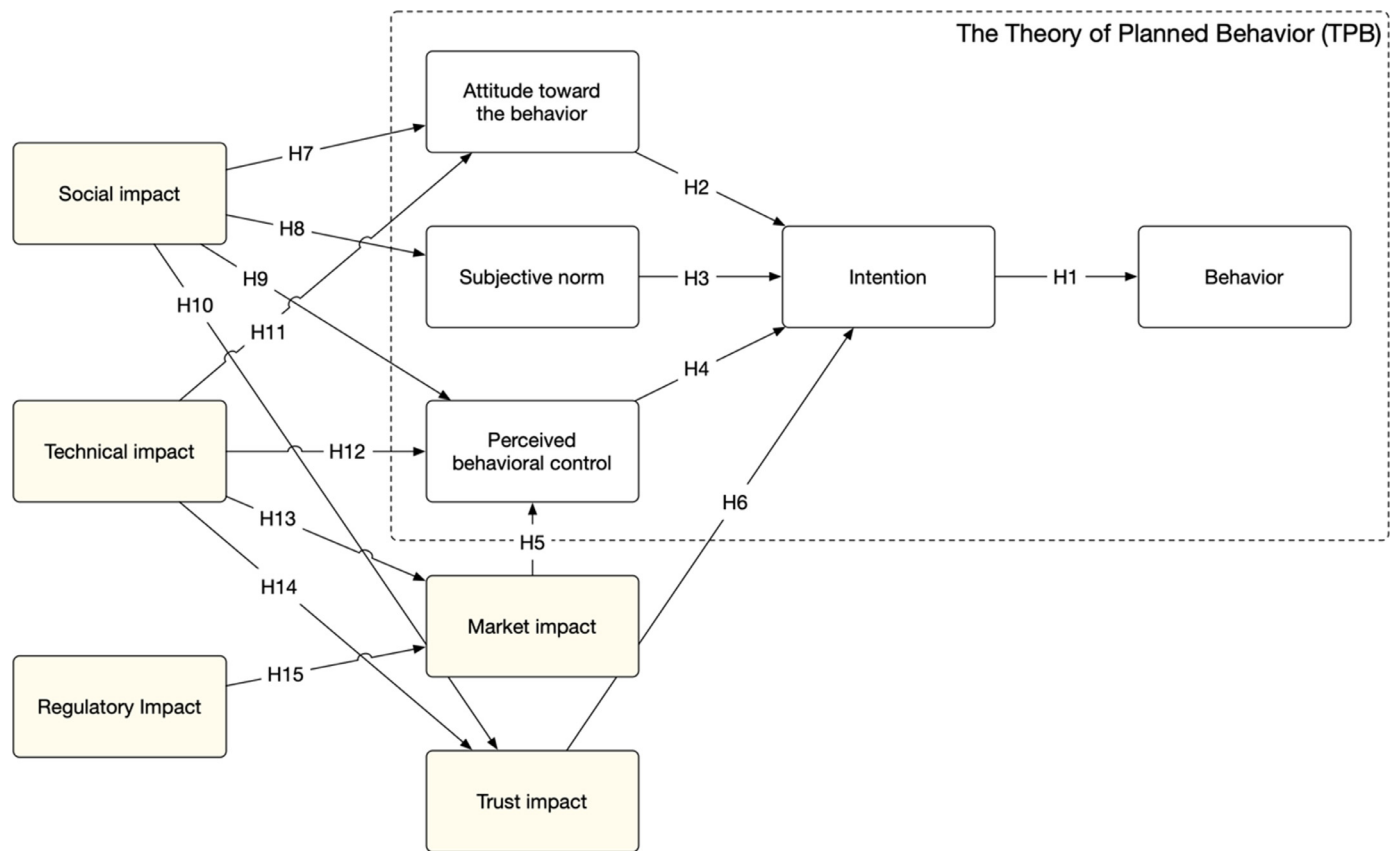


Fig. 3. The proposed model with hypotheses.

were used and selected carefully from respected literature to create the proposed model and hypothesis, as shown in Fig. 3 below:

The model was designed based on the theory of planned behavior (TPB) and extended with five new constructs (Market impact, Trust impact, Social impact, Technical impact, and Regulatory impact).

This new model adds new perspectives to academic studies that contribute to previous research—using the SEM tool to develop a comprehensive model [51] aimed at increasing the understanding of users interacting with the NFT Metaverse.

This research conducted an online survey with different background users worldwide with different levels of use and experience. We intend to use essential control variables with some specific questions to have good analysis results at the end.

6. Research results

The proposed model is approved by an online test using Google Forms and Prolific based on studies of human behavior and its impact on technology usage and adoption. A two-week survey was conducted with the creators, traders, and enthusiasts of NFTs. Having a thorough understanding of the NFT metaverse and the factors influencing the level of adoption and use was necessary to substantiate the proposed model. For each measurement item (32 specific questions), there are five scales (5 Likert points), starting with no support (strongly disagree) and ending with strong support (strongly agree).

For this experiment, we added nine demographic questions to classify them as control variables including three specific questions to evaluate the respondents' knowledge of the NFT metaverse. In the methodology, we are using the Partial Least Squares-Structural Equation Modeling (PLS-SEM) algorithm and the statistical data analysis using (Smart-PLS 4) [78]. This study used a reflective measurement model on Structural Equation Modeling (SEM) to perform two tests, first using PLS-

SEM standard algorithm to validate the constructs and measurement items and their reliability by calculating (Convergent Validity, Average Variance Extracted, Internal Consistency Reliability, Discriminant Validity, Fornell-larcker criterion, and Cross loadings) [39], and will use the R Square statistics to explain the variance in the endogenous variable which is explained by the exogenous variables. Second, using bootstrapping to measure the hypothesized significance by measuring (The p-value, t-value, and path coefficients) and examining the Outer loadings and Outer weights to estimate relationships in reflective measurement models and test multiple regression of a construct on its set of indicators, also to measure the indirect impact using the p-value. and find the hidden influence of the constructs.

6.1. Descriptive statistics

Table 1 shows the samples collected from 459 responses; international nations were surveyed online for two weeks.

As a result of the observation demographic results, men 365 constituted 79.40% of the collected data, while women 95 constituted 20.60%, which may show men are mostly interested in this kind of topic and research. In general, our results will represent a majority of men's opinions than women's in this study. The ages (20s~40s) were the most, 438 (95.42%) respondents, which shows that midlife is the average age represented in this study. Most of the responses were from the United Kingdom with 93 (20.26%) respondents, the United States with 64 (13.94%) respondents, and South Africa with 52 (11.33%) respondents. The occupation was mainly from the private sector 300 (65.36% respondents, and 60 (13.07%) students. The Education level was as shown, undergraduate degree 245 (53.38%) respondents, graduate degree (Master or Ph.D. degree) 144 (31.37%) respondents, and Elementary or high school 69 (15.03%) respondents. The annual income of more than (20,000 USD) was 310 (67.54%) respondents. Between occupation, education, and in-

come, responses are mostly from those working in the private sector while they are studying at universities, which qualifies them to acquire knowledge in both education and practical business [Table 2](#).

Table 2
Demographic information.

Item	Values	Frequency	Percentage
Gender			
	Male	365	79.40%
	Female	95	20.60%
Age			
	20'	233	50.76%
	30'	149	32.46%
	40'	56	12.20%
	50'	17	3.70%
	60'	3	0.65%
	70'	1	0.22%
Regions (which region you live in now)?			
	UNITED KINGDOM	93	20.26%
	UNITED STATES	64	13.94%
	SOUTH AFRICA	52	11.33%
	PORTUGAL	44	9.59%
	POLAND	35	7.63%
	ITALY	22	4.79%
	SPAIN	19	4.14%
	MEXICO	16	3.49%
	GERMANY	12	2.61%
	KOREA (South)	11	2.40%
	NETHERLANDS	10	2.18%
	The rest	81	17.65%
Occupation			
	Public Sector	300	65.36%
	Student	60	13.07%
	Freelancer	41	8.93%
	Private Sector	40	8.71%
	Online Job	16	3.49%
	I have no Job	2	0.44%
	Retired	0	0.00%
Education			
	Undergraduate degree	245	53.38%
	Graduate degree (Master or PH.D. degree)	144	31.37%
	Elementary or high school	69	15.03%
	Uneducated	1	0.22%
The yearly household income			
	More than 40,000\$	310	67.54%
	20,001\$ ~ 30,000\$	61	13.29%
	30,001\$ ~ 40,000\$	57	12.42%
	1,000\$ ~ 5,000\$	34	7.41%
	15,001\$ ~ 20,000\$	32	6.97%
	10,001\$ ~ 15,000\$	29	6.32%
	5,000\$ ~ 10,000\$	28	6.10%
	Prefer not to say	21	4.58%
	Less than 1000\$	5	1.09%
Evaluate your understanding of NFTs and Metaverse			
	Average	292	63.62%
	High	101	22.00%
	Low	66	14.38%
Do you have any experience with NFTs (search, buy or create)? Or dealing with NFT & crypto wallets?			
	Yes	357	77.78%
	No	102	22.22%
If you plan to buy NFT, is it essential to know who the NFT creator and current owner are?			
	High	201	43.79%
	Average	196	42.70%
	Low	62	13.51%

Moreover, we asked the respondents three more specific questions about the study topic (NFT Metaverse). The first question is (Evaluate your understanding of NFTs and Metaverse), and the answers: (High) were 101 (22.00%) respondents, (Average) 292 (63.62%) respondents, and (Low) 66 (14.38%) respondents. This a clear note that most of the respondents have an average level of understanding of the two terms (NFT & Metaverse), which may be considered a normal distribution for this kind of study on a user level.

The second question is (Do you have any experience with NFTs (search, buy, or create)? Or dealing with NFT & crypto wallets?), and the answers: (Yes) were 357 (77.78%), and (No) were 102 (22.22%). This shows the majority of this experience from people who have experience and their answers were more accurate.

The third question is (If you plan to buy NFT, is it essential to know who the NFT creator and current owner are?), and the answers: (High) was 201 (43.79%) respondents, (Average) 196 (42.70%) respondents, and (Low) were 62 (13.51%) respondents. This means that there is significant interest in the origin of the NFT and who the current owner (investor) is, reflecting the impact of the original character of NFT and the forward-thinking merit of engaging in the NFT metaverse.

6.2. Measurement model assessment

There will be reliability, validity, and factor loading tests for each measurement item [\[40\]](#). As shown in [\(Table 3\)](#). A construct's convergence validity is its association between two measurement items (Loadings >0.70 or more than 0.5, and Indicator Reliability >0.50 or it accepted less value if AVE is established); not all items are associated with each other for the same construct in this model, but the AVE is established).

Average Variance Extracted (AVE) calculates how much variance is captured by a construct based on the amount of variance caused by measurement errors (AVE >0.50, which is accepted for all our constructs). A measure of internal consistency reliability is the correlation between multiple items measuring a given construct (Composite Reliability and Cronbach's Alpha >0.60, Which means the reliability for all constructs is established).

Discriminant Validity describes the constructs' relationship to each other (Using Cross loadings and the Fornell-larcker criterion shows that all constructs are empirically distinct from each other and the Discriminant Validity exists).

According to Cronbach's alpha and composite reliability values, the items are reliable, which enables the statement that the internal consistency of scale items has been established. A cross-loadings [\(Table 4\)](#) and Fornell-Larcker criterion [\(Table 5\)](#) were used to determine discriminant validity in this study.

The cross-loading criterion results it is showing perfect indicators [\(Table 4\)](#); most items have a value of more than (0.7) indicating a significant loading for each construct in each row of the factor matrix, making them distinct concepts. As opposed to other construction loads, cross-loading measures the external indicator load of the respective structure. Indicators with higher cross loads than their external loads have a problem with discriminative validity. This study demonstrates that the fixtures' discriminative validity is supported by higher loads for the linked indicators than for the other cross-loadings.

The Fornell-Larcker criterion measures the degree of variance shared between the latent variables by comparing the square root of the AVE value with latent variable correlations [\(Table 5\)](#). Reflective elements can be evaluated using this method. For our results, the diagonal value shows a higher correlation than other constructs, which indicates viability.

6.3. Structural model assessment

To assess the proposed model, we will measure the R-square value for all dependent constructs, and the path coefficient to assess the rela-

Table 3
Measurement model results.

Latent Variable	Indicators	Convergent Validity			Internal Consistency Reliability			Discriminant Validity
		Loadings	Indicator Reliability	AVE	Composite Reliability 0.60 - 0.90		Cronbach's Alpha	
		>0.70	>0.50	>0.50	(rho_a)	(rho_c)	0.60 - 0.90	
Attitude toward behavior	ATB1	0.940	0.884	0.864	0.856	0.927	0.843	Yes
	ATB2	0.918	0.843					
Behavior	B1	0.903	0.815	0.841	0.823	0.914	0.812	Yes
	B2	0.930	0.865					
Intention	I1	0.980	0.960	0.960	0.959	0.980	0.959	Yes
	I2	0.980	0.960					
Market	M1	0.824	0.679	0.551	0.768	0.826	0.720	Yes
	M2	0.769	0.591					
	M3	0.818	0.669					
	M4	0.512	0.262					
Perceived behavioral control	PBC1	0.939	0.882	0.646	0.862	0.777	0.623	Yes
	PBC2	0.652	0.425					
Regulatory	R1	0.736	0.542	0.605	0.816	0.859	0.789	Yes
	R2	0.859	0.738					
	R3	0.766	0.587					
	R4	0.746	0.557					
Social	S1	0.887	0.787	0.781	0.863	0.914	0.860	Yes
	S2	0.861	0.741					
	S3	0.901	0.812					
Subjective norm	SN1	0.888	0.789	0.776	0.713	0.874	0.712	Yes
	SN2	0.874	0.764					
Technical	TL1	0.798	0.637	0.530	0.780	0.849	0.778	Yes
	TL2	0.682	0.465					
	TL3	0.857	0.734					
	TL4	0.872	0.760					
	TL5	0.733	0.537					
Trust	T1	0.788	0.621	0.627	0.889	0.909	0.879	Yes
	T2	0.756	0.572					
	T3	0.733	0.537					
	T4	0.683	0.466					
	T5	0.780	0.608					
	T6	0.731	0.465					

Table 4
Cross loadings.

	Attitude toward behavior	Behavior	Intention	Market	Perceived behavioral control	Regulatory	Social	Subjective norm	Technical	Trust
ATB1	0.940	0.371	0.766	0.197	0.413	0.189	0.642	0.631	0.356	0.701
ATB2	0.919	0.332	0.618	0.173	0.366	0.176	0.576	0.617	0.412	0.638
B1	0.317	0.905	0.433	0.074	0.274	0.031	0.349	0.346	0.193	0.251
B2	0.376	0.929	0.502	0.137	0.291	0.061	0.354	0.351	0.233	0.318
I1	0.738	0.51	0.980	0.207	0.43	0.185	0.617	0.598	0.334	0.641
I2	0.732	0.494	0.980	0.245	0.417	0.192	0.598	0.607	0.358	0.642
M1	0.195	0.098	0.217	0.824	0.282	0.231	0.117	0.131	0.348	0.237
M2	0.071	0.022	0.093	0.768	0.176	0.235	0.035	0.022	0.187	0.066
M3	0.175	0.094	0.193	0.821	0.297	0.221	0.118	0.106	0.307	0.169
M4	0.126	0.141	0.164	0.512	0.133	0.15	0.139	0.22	0.204	0.131
PBC1	0.453	0.351	0.46	0.264	0.954	0.141	0.305	0.362	0.356	0.387
PBC2	0.124	0.041	0.14	0.289	0.617	0.159	0.052	0.096	0.197	0.15
R1	0.231	0.066	0.22	0.241	0.231	0.737	0.194	0.172	0.173	0.186
R2	0.079	-0.006	0.085	0.275	0.153	0.861	0.094	0.073	0.121	0.077
R3	0.16	0.07	0.159	0.158	0.022	0.763	0.173	0.162	0.09	0.143
R4	0.16	0.051	0.151	0.171	0.065	0.745	0.128	0.131	0.107	0.164
S1	0.578	0.311	0.51	0.111	0.201	0.119	0.887	0.579	0.322	0.497
S2	0.544	0.337	0.527	0.07	0.208	0.168	0.861	0.603	0.297	0.559
S3	0.618	0.365	0.601	0.178	0.308	0.195	0.902	0.619	0.4	0.597
SN1	0.598	0.322	0.521	0.08	0.256	0.104	0.646	0.888	0.258	0.492
SN2	0.585	0.349	0.564	0.194	0.337	0.19	0.549	0.874	0.337	0.534
TL1	0.333	0.227	0.278	0.125	0.208	0.034	0.337	0.28	0.757	0.420
TL2	0.266	0.091	0.2	0.137	0.165	0.069	0.294	0.254	0.732	0.306
TL3	0.215	0.148	0.214	0.43	0.34	0.172	0.199	0.171	0.684	0.205
TL4	0.418	0.211	0.328	0.154	0.239	0.083	0.387	0.342	0.780	0.438
TL5	0.245	0.152	0.243	0.442	0.338	0.211	0.189	0.174	0.680	0.284
T1	0.595	0.213	0.525	0.175	0.319	0.102	0.494	0.421	0.335	0.799
T2	0.422	0.172	0.379	0.182	0.234	0.133	0.346	0.385	0.316	0.683
T3	0.665	0.302	0.592	0.129	0.232	0.195	0.592	0.517	0.361	0.859
T4	0.612	0.275	0.576	0.176	0.319	0.124	0.504	0.491	0.367	0.872
T5	0.541	0.285	0.489	0.127	0.329	0.123	0.485	0.45	0.353	0.731
T6	0.56	0.219	0.517	0.24	0.342	0.155	0.513	0.482	0.438	0.789

Table 5
Fornell-larcker criterion.

	ATB	B	I	M	PBC	R	S	SN	TL	T
ATB	0.930									
B	0.380	0.917								
I	0.750	0.512	0.980							
M	0.200	0.117	0.231	0.742						
PBC	0.420	0.309	0.432	0.315	0.804					
R	0.196	0.051	0.192	0.284	0.170	0.778				
S	0.657	0.383	0.620	0.138	0.273	0.184	0.884			
SN	0.671	0.380	0.615	0.154	0.335	0.165	0.680	0.881		
TL	0.410	0.234	0.353	0.366	0.363	0.162	0.386	0.336	0.728	
T	0.722	0.312	0.655	0.214	0.373	0.176	0.626	0.581	0.458	0.792

tionships in the same model. According to the R2 value, the independent variable is responsible for explaining a part of the dependent variable [39]. The correlation results between them were shown in (Fig. 4).

R2 values are considered acceptable in social science and behavioral studies. (26.3%) for Behavior (B), which explains the effect of users' behavior and control on the engaging decision with NFT-Metaverse. (61.4%) for Intention (I), which explains the high-level impact of users' intentions on the engaging decision with NFT-Metaverse. (46.1%) for Attitude toward behavior (ATB), which explains the effect of users' ability or capability to enforce the engaging decision with NFT-Metaverse. (46.2%) for Subjective norm (SN), which explains the effect of users' people's stated motivation on the engaging decision with NFT-Metaverse. (19.1%) for Perceived behavioral control (PBC), which explains the effect of users' emotions, beliefs, or behavior toward the engaging decision with NFT-Metaverse. (18.5%) for Market (M), which explains the effect of the market situation, stability, and reputation with

the future expectations on the engaging decision with NFT-Metaverse. (44.6%) for Trust (T), which explains the effect of users' level of comfort, confidence, and security on the engaging decision with NFT-Metaverse.

The paths analysis in (Fig. 4) and (Table 6) estimated the p-values and the path coefficients, the results came to accept all 15 hypotheses.

6.4. Indirect path analysis

The indirect effect in structural equation modeling (SEM) describes the impact of one causal variable on others via one or more intervening variables, that lend a causal interpretation to parameter estimates [21,91]. This comprehensive research aims to understand all the casualities and impacts between the external constructs on intentions and behavior, rising the indirect path will help to understand more about our proposed model and other correlations. Table 7, shows the significance of the proposed external variables (Social, Technical, Regulatory,

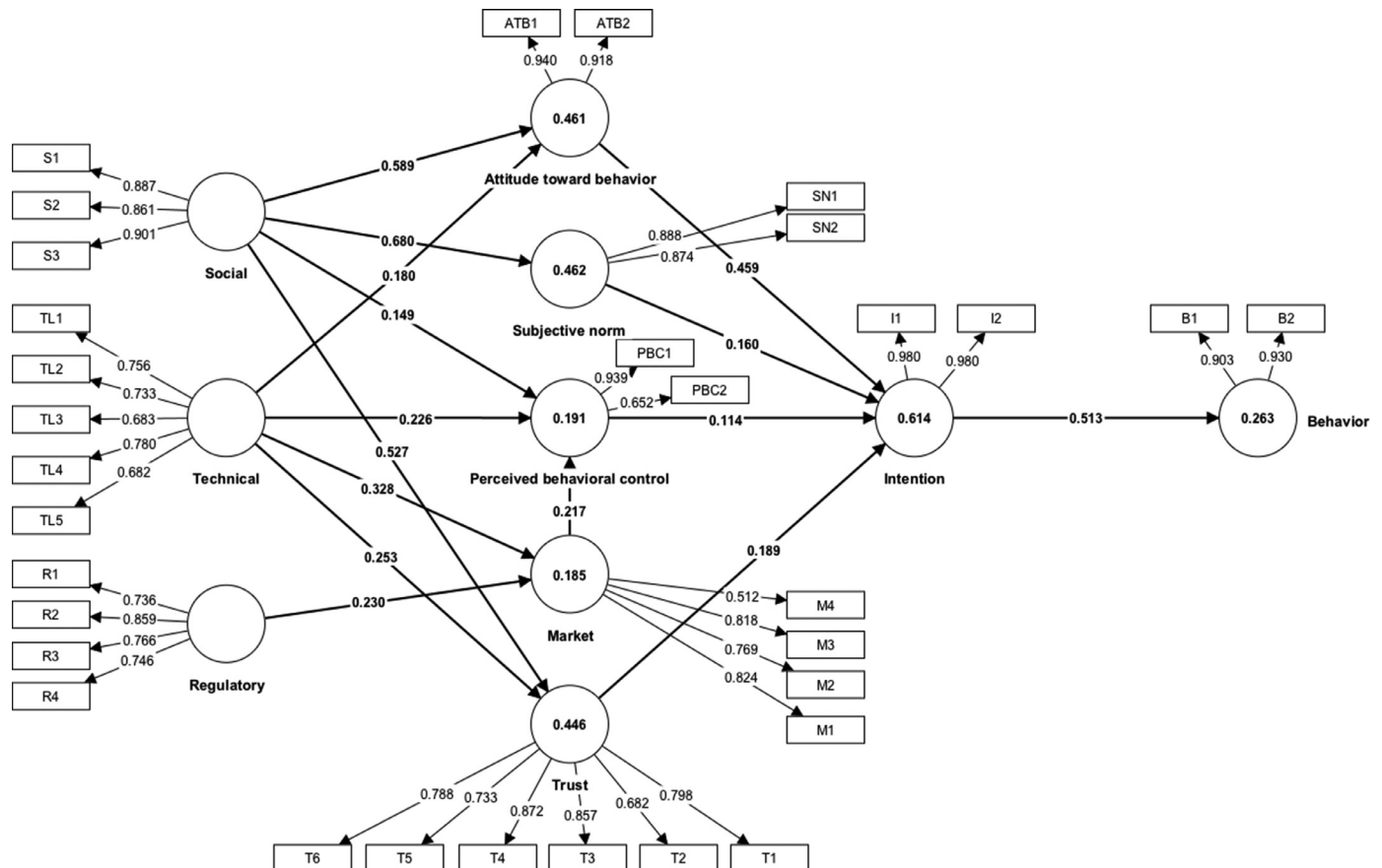


Fig. 4. Path analysis results.

Table 6
Hypotheses test results.

Hypotheses	Path	Path Coefficients	t Values	p Values	2.5% Confidence Intervals	95% Confidence Intervals	Significance (p<0.05)?
H1	Intention -> Behavior	0.513	14.316	0.000	0.441	0.582	Yes
H2	Attitude toward behavior -> Intention	0.459	8.401	0.000	0.347	0.559	Yes
H3	Subjective norm -> Intention	0.160	3.428	0.001	0.069	0.253	Yes
H4	Perceived behavioral control -> Intention	0.114	3.064	0.002	0.042	0.187	Yes
H5	Market -> Perceived behavioral control	0.217	3.817	0.000	0.109	0.333	Yes
H6	Trust -> Intention	0.189	3.589	0.000	0.089	0.293	Yes
H7	Social -> Attitude toward behavior	0.589	16.525	0.000	0.514	0.655	Yes
H8	Social -> Subjective norm	0.680	27.242	0.000	0.63	0.727	Yes
H9	Social -> Perceived behavioral control	0.149	2.693	0.007	0.036	0.253	Yes
H10	Social -> Trust	0.527	13.739	0.000	0.449	0.6	Yes
H11	Technical -> Attitude toward behavior	0.180	4.529	0.000	0.104	0.261	Yes
H12	Technical -> Perceived behavioral control	0.226	3.758	0.000	0.107	0.341	Yes
H13	Technical -> Market	0.328	6.535	0.000	0.225	0.422	Yes
H14	Technical -> Trust	0.253	5.918	0.000	0.17	0.338	Yes
H15	Regulatory -> Market	0.230	5.36	0.000	0.152	0.316	Yes

Table 7
Indirect effect.

The indirect path	The indirect effect	Original sample (O)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Social -> Attitude toward behavior -> Intention -> Behavior	Social->Behavior	0.138	0.02	6.843	0.000
Social -> Subjective norm -> Intention -> Behavior		0.056	0.018	3.131	0.002
Social -> Trust -> Intention -> Behavior		0.051	0.016	3.204	0.001
Social -> Subjective norm -> Intention	Social->	0.109	0.033	3.342	0.001
Social -> Trust -> Intention		0.099	0.031	3.234	0.001
Social -> Attitude toward behavior -> Intention	Intention	0.270	0.037	7.356	0.000
Technical -> Trust -> Intention -> Behavior	Technical->	0.024	0.007	3.308	0.001
Technical -> Market -> Perceived behavioral control -> Intention -> Behavior		0.004	0.002	2.026	0.043
Technical -> Attitude toward behavior -> Intention -> Behavior	Behavior	0.042	0.011	3.918	0.000
Technical -> Perceived behavioral control -> Intention -> Behavior		0.013	0.006	2.03	0.042
Technical -> Trust -> Intention	Technical->	0.048	0.014	3.384	0.001
Technical -> Market -> Perceived behavioral control -> Intention		0.008	0.004	2.081	0.037
Technical -> Attitude toward behavior -> Intention	Intention	0.083	0.020	4.126	0.000
Technical -> Perceived behavioral control -> Intention		0.026	0.012	2.109	0.035
Regulatory -> Market -> Perceived behavioral control -> Intention -> Behavior	Regulatory-> Behavior	0.003	0.001	2.003	0.045
Regulatory -> Market -> Perceived behavioral control -> Intention	Regulatory-> Intention	0.006	0.003	2.033	0.042
Market -> Perceived behavioral control -> Intention -> Behavior	Market-> Behavior	0.013	0.006	2.268	0.023
Market -> Perceived behavioral control -> Intention	Market-> Intention	0.025	0.011	2.325	0.020
Trust -> Intention -> Behavior	Trust-> Behavior	0.097	0.027	3.543	0.000

Market, and Trust), on intention and behavior. Smart PLS 4, helps to find 19 passable indirect effects, which are significantly supported, that give a visualization for the possibilities this model can predict and helps to understand how this model can explain the user decision-making to engage with NFT-Metaverse.

Both social and technical constructs show a multi-direction impact on intention and behavior, we may consider them as the key elements that influence users' decision-making to engage with NFT-Metaverse. Further discussion will be present in the implication part.

7. Research discussion

7.1. Discussion

This research aims to find a comprehensive understanding of the factors that impact the users' decision-making to engage with NFT-Metaverse. In another hand, our goal is to enhance the usability and experience with NFT-Metaverse, which requires knowledge of major factors that impact users to move to engage with it. The relationship between the user and technology is complicated to be explained, which is why we are using a TPB model to assist this goal and support the academic argument [2]. Furthermore, to achieve comprehensive knowl-

edge, we are using the SEM technique and mapping literature analysis on NFT and Metaverse [48]. As a result, we found five proposed factors that have a strong impact on the users' engagement decision with NFT-Metaverse, which are (Social, Technical, Regulatory, Market, and Trust).

The proposed model is supported by well-known literature and theories to present a valid hypothesis and get a meaningful result [9,10,17,41,42,71]. Testing this model with experience people was helpful to get an accurate answer. By using Smart-PLS 4, we got clear indicators explaining what this study aims for, both theoretical and practical implications will be explained in the next section.

7.2. Theoretical implication

The main objective of this research is to identify the factors that influence the decision-making process related to engagement with the NFT Metaverse. We present the direct and indirect effects considered by this study using the TPB theory and five exogenous constructs. After a proper analysis with SmartPLS 4, we found several theoretical implications that need to be discussed.

Social influence and the people we believe have a direct impact on the actions, motivations, beliefs, and trust of others. Further results show

that the indirect influence on intention and behavior is through all directly impacting factors. Both effects show a serious association between social behavior and behavior in the decision-making process of users engaging in the NFT Metaverse. This describes Social as an important aspect to consider when conducting social science research on the NFT and the Metaverse, including blockchain-based technologies.

We found that technical criteria directly affect users' behavior, beliefs, trust, market stability, and reputation. Further results show that the indirect influence on intention and behavior is through all directly impacted factors. Both effects show a serious association between technology and behavior in the decision-making process of users engaging in the NFT Metaverse. The technology is a major influence in the NFT and the Metaverse, which must be clearly described and defined before blockchain technology advances.

In our study, the regulations influence the market, which ensures that the enforcement of regulations and government involvement to control and regulate market behavior has a positive effect on intent and behavior. Further, the indirect influence on intention and behavior is through the same direct impact factor. Both effects show a serious association between regulation and behavior in the decision-making process of users participating in the NFT Metaverse.

We found that the market directly affects users' beliefs and indirectly affects their intentions and behavior. Both effects show a serious correlation between market and behavior in the decision-making process of users engaging in the NFT Metaverse. Market condition, reputation, and stability factors change people's beliefs and behavior in usage technologies, showing a strong influence in the case of the NFT Metaverse. Market monitoring and clear indicators may show higher participation levels and increased adoption of the NFT Metaverse.

We found that trust represents the user's level of comfort, confidence, and security when using technology which shows a direct impact on intention and an indirect impact on behavior. Trust is the primary factor in most studies of technological developments [27,74,81]. It shows a tremendous impact on behavior toward NFT Metaverse engagement decision. Increasing trust sure it will enhance the user experience and promote the technology, Users' trust in NFT Metaverse will shift the engagement and enhance the confidence between the user and NFT.

The overall result indicates that social science studies support this type of comprehensive study and the tools used to approve the research arguments and hypotheses. Each factor has its effect and at the same time joins as a mediator of influence transmission in correlations, giving us a meaningful translation to understand the engagement with the NFT Metaverse.

7.3. Practical implication

This research presents practical implications for gaining traction for the blockchain industry, decision-makers, developers, and users. By researching the factors that influence users' decisions to engage with the NFT Metaverse, and proposing a comprehensive model to cover the most affecting factors collected from the literature in this field. This model explains the strength of the effect imposed by user behavior, which this study finds and agrees on the effect of its validity on the NFT Metaverse market. The factors in this study show a significant direct and indirect influence on the decision-making of the NFT Metaverse. TPB theory help to understand decision-making and user behavior, supported by five external factors (social, technical, organizational, market, and trust) to comprehend the results.

Social shows a significant direct and indirect impact, which explains the strength of social influence on user behavior. Further, it is desirable to consider social connections via social media as an external force to be taken care of during the life cycle of the NFT Metaverse project. Increasing the promotion of the use of NFT Metaverse should have a strong positive impact on the engagement rate.

Technology shows significant direct and indirect influence, explaining how technical details and features affect service quality and delivery such as interaction, interoperability, and stability in user behavior. The technical recommendations stand for designing a service that fits user expectations and the entire market's needs. From friendly front-end design and features to back-end support, security, and efficiency.

Regulation shows significant direct and indirect influence, which explains the role of regulations and government in monitoring and managing NFT Metaverse adoption to secure usage and investments. This study highlights the role of regulations in guiding the market and being part of the development processes by monitoring both sides (users and service providers). On the other hand, the developer and the business team must take into account the latest regulations and instructions issued by the government and work in line with them.

The market shows a significant direct and indirect impact, which explains the role of the current market situation, stability, and reputation in the future expectations on the decision-making regarding the NFT Metaverse, as users may engage based on market price stability. Considering the current and the future market with analysis of the development level and customer needs in the service development stage may enhance engagement and usage.

Finally, trust shows a significant direct and indirect effect, which explains the user's expression of confidence in using technology; to what extent can user trust technology. Trust can be demonstrated by the user's level of comfort, confidence, and security. It is recommended to enhance user trust by improving transparency and security in platform design and features. A greater focus on ensuring trust will broaden participation in the NFT Metaverse.

The general recommendations of the service provider and the decision maker are to consider all the aspects mentioned above during the development phase. NFT Metaverse is the future technology that may provide unexpected services to improve human life and services.

8. Conclusion

This research aims to identify the factors that influence a user's decision to engage in the NFT Metaverse. We provide NFT metaverse enthusiasts with the knowledge needed regarding technological advancements and the recognition of risk factors in investment decisions.

We used the most popular theory that helps to understand user decisions and human behavior which is the theory of planned behavior (TPB) [43]. However, to have a comprehensive understanding of the effects, the TPB lacks an explanation of user behavior and intent toward the engagement of the NFT metaverse regarding technological complexity and recent developments. Therefore, by mapping several related literature and reports, we propose an extension of TPB by adding five new constructs that demonstrate user behavior towards the NFT metaverse from different perspectives, which they are (Social, Technical, Regulatory, Market, and Trust). Statistical analysis was performed using partial least squares structural equation modeling (PLS-SEM) and Smart-PLS 4 [94].

The results show substantial direct and indirect effects on the user engagement decision with NFT Metaverse. By researching user intentions and behavior, we found that all five new constructs have a significant impact on the engaging decision of the NFT Metaverse. The proposed model offers a complex view of how the impact is described and what hidden aspects of engaging decisions are discovered. As we explain these aspects and impacts, we recommend further research and adoption of the NFT Metaverse using this model or an extended model. Users can find in this study majority of answers to their concerns about engaging in NFT Metaverse including awareness about investment decisions and expanding the knowledge base. In addition, the leading stakeholders of the NFT and Metaverse industries and the engineering team responsible for development should consider the findings in this research as a supportive guideline for future developments.

9. Limitation and future research

Nevertheless, some limitations exist in this study. Around 80% of the respondents were men between the ages (20' and 30'), which is bise to represent women in this study. Also, 65% were employed in the public sector, which indicates that the results lacked an explanation of the mindsets of others. We recommend that future research in the same field encourages women to join this type of research at different ages and categorize the research into a particular occupation.

Declaration of Competing Interest

Dear Editor Office, In Regard to our submission to your journal, all authors declare that they have no conflicts of interest.

Data availability

Data will be made available on request.

Appendix

Constructs and measurement items [Table 8](#).

Table 8
The constructs and measurement items.

Construct	Definitions	Item name	The Question	The sources
Attitudes toward Behaviors	The human ability or capability to act could be a positive or negative behavior	ATB1	Engaging in NFT Metaverse would be a good idea	[4,6,76]
Subjective Norms	People's stated motivation and their action plan	ATB2	Engaging in NFT Metaverse would be pleasant	
		SN1	Most people who are essential to me approve of my engagement in NFT Metaverse	[2,4]
Perceived Behavioral Control	The emotion, belief, or behavior toward a particular thing, person, or event. Situations often result from experiences or upbringing and can strongly influence behavior and change it	SN2	Most people like me engage in NFT Metaverse, following their primary research on it	
		PBC1	I am confident that I can engage in NFT Metaverse	[2–4]
Intention	The external pressure felt by individuals to perform or not perform certain behaviors	PBC2	My engagement in NFT Metaverse is up to me	
Behavior	The strength and power of faith lead to control over which products can be accessed. It measures the extent doing this action makes the goal more accessible or more difficult	I1	I will engage in NFT Metaverse	[4,34]
		I2	I intend to engage in NFT Metaverse	
Trust	The expression of confidence between people and technology; how much the user can trust technology. Trust can be shown by the user's level of comfort, confidence, and security when using technology	B1	Engage in NFT Metaverse is something I have done	[3,4]
		B2	I have a lot of experience of engaging in NFT Metaverse	
		T1	The engaging in NFT Metaverse is trustworthy	[46,61]
		T2	NFT Metaverse ethics are built on keeping promises and commitments	
		T3	I trust the engaging in NFT Metaverse keeps my best interests in mind	
		T4	I find it acceptable to trust the NFT Metaverse	
		T5	The NFT Metaverse's behavior meets my expectations	
Regularity	The legal systems that are established by the authorities to monitor technologies and assure that service providers and consumers meet their commitments and avoid fraud	T6	The NFT Metaverse cares about servicing its customers	
		R1	Government support of NFT Metaverse would provide an incentive for engagement	[67], Albayati 2020
		R2	Government regulations and monitoring would reduce the risks associated with engaging in NFT Metaverse	
		R3	The government should support and be responsible for regulating the engagement in NFT Metaverse	
Social impact	The effect on an individual's perception of people they believe in or trust; this impact guides the person to behave differently toward using technologies	R4	Regulations and government insurance should exist to protect the engagement in NFT Metaverse	
		S1	My colleagues think that I should engage in NFT Metaverse	[9,20,44]
Technical impact	The technical features that influence service quality and delivery impact users' attitudes and intentions, such as interactivity, interoperability, and stability	S2	My family and who I trust, believe that I should engage in NFT Metaverse	
		S3	My friends think that I should engage in NFT Metaverse	
		TL1	On the NFT Metaverse, it seems everything is easy to understand and use	[12,17]
		TL2	I expect the NFT Metaverse is simple to engage, even when using it for the first time	
		TL3	It should be easy to find the information I need to engage with NFT Metaverse	
Market impact	The current market situation, stability, and reputation with future expectations show the impact on individual performance and decisions	TL4	The structure and contents of NFT Metaverse are easy to understand	
		TL5	I expect when navigating the NFT Metaverse, that I feel in control of what I can do	
		M1	NFT Metaverse's distribution and announcement processes should be efficient	[14,71]
		M2	The service provider should consider changes in customers' needs in NFT Metaverse	
		M3	The NFT Metaverse should be up-to-date with the market need	
		M4	The nature of competitors' strategies and actions are impacting the service quality of NFT Metaverse	

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