Roles of Information Security and Benefits in Forming User Satisfaction of Metaverse

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Abstract— The metaverse is a type of virtual world that has been steadily drawing the attention of Internet users. As its utility continues to increase, it is now used academically and commercially. This study suggests the theoretical framework to identify the leading factors of satisfaction of metaverse users. Data were gathered from the actual users who had experienced the metaverse. Partial least square (PLS) technique was applied to conduct structural equation modeling (SEM). The results of the study found that trust is significantly related to satisfaction. The empirical results triggered that utilitarian value has a significant influence on satisfaction. The findings revealed that hedonic value is the precursor of satisfaction. The results of this paper will offer meaningful implications for the security and marketing fields.

Keywords—Metaverse, information security, utilitarian benefits, hedonic benefits, PLS-SEM

I. INTRODUCTION

The virtual world has developed with the advent and spread of the Internet. Internet users establish their new homes in the virtual world. They manage avatars and interact with others [1]. Among the ideas of the virtual world, the metaverse is representative [2]. The metaverse is a combination of meta (Greek word meaning after, post, or beyond) and the universe [3]. As can be seen from the expression, users can experience and live in infinite possibilities in the metaverse [4].

Companies have started using the metaverse for commercial purposes [5]. Online game providers have created an environment where people can have fun using the metaverse as a space [6]. Manufacturers of virtual reality (VR) and augmented reality (AR) hardware have developed advanced tools that allow humans to experience the metaverse more realistically [7]. The metaverse market is steadily growing and users are becoming more familiar with it [8].

People trade and pay for virtual goods on it [9]. They are very sensitive about whether their personal or payment information is well secured [10]. Metaverse's information security may significantly affect users' satisfaction. Metaverse users also get useful help for their studies or work [11]. They benefit from utilizing the high-quality information provided by the metaverse [12]. At the same time, they enjoy being active in it [13]. They obtain many pleasure benefits by completing quests or interacting with others [14]. In this sense, utilitarian benefits and hedonic benefits may drive users' satisfaction. In summary,

the satisfaction of metaverse users would be determined by information security, utilitarian benefits, and hedonic benefits. The current study intends to empirically verify this relationship between the scales.

This paper unfolds as follows. Section 2 proposes hypotheses based on related studies. Section 3 guides the scale development process and data collection process. Section 4 introduces the validation of measurement tools and hypothesis testing. Section 5 presents a summary, contributions, and limitations.

II. RELATED STUDIES AND HYPOTHESES

A. Information Security (ISE)

Information security has been regarded as the crucial determinant of behaviors of information technology (IT) users in several domains. It significantly affects the use of IT artifacts [15]. Perceive risk about privacy concerns harms the continuance intention of IT users by inhibiting attitude [16]. Information privacy concerns undermine the behavioral intention of users [17]. Privacy concern also impedes user trust [18]. Hasan al. [19] argued that when there is much potential loss associated with providing personal information to IT, brand loyalty decreases. Metaverse users enter their personal information and payment information to trade. If the level of information security is low, they are not satisfied with it. Therefore, this paper posits that information security drives user satisfaction.

H1. Information security significantly affects user satisfaction.

B. Utilitarian Benefits (UTB)

Utilitarian benefits deal with convenience, helpfulness, efficiency, and task fitness [20]. They also include economic advantages such as monetary savings [21]. Utilitarian benefits lead to the use of IT devices [15]. If metaverse users get more useful help from it, their satisfaction will increase. Thus, the present study postulates that utilitarian benefits facilitate user satisfaction.

H2. Utilitarian benefits significantly affect user satisfaction.

C. Hedonic Benefits (HEB)

Hedonic benefits are described as a person's emotional state, such as pleasure and satisfaction from social interaction or the use of new technology [22]. It influences IT users' behavioral intentions [23]. When IT has greater hedonic value, people try to use them more frequently [24]. The more users experience pleasure from using metaverse, the more satisfied they will be with it. Accordingly, this work surmises that hedonic benefits are the key antecedent of user satisfaction.

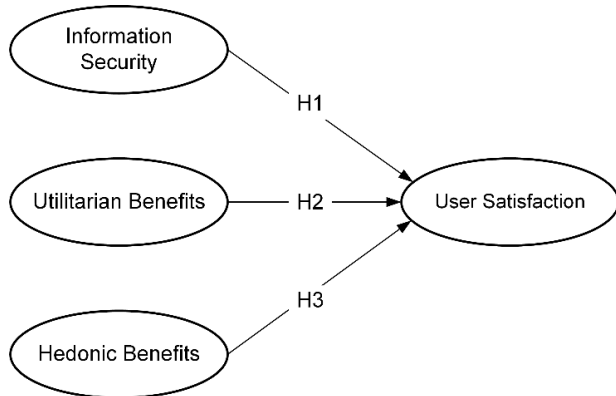*H3. Hedonic benefits significantly affect user satisfaction.*

Figure 1. Research Model

III. METHODOLOGY

A. Instrument Development

This research conducted a cross-sectional analysis. We took survey questions from previous demonstrated studies. The measurements were slightly adjusted for the metaverse context. The author initially write the questionnaire in English. A Korean researcher fluent in English translated it into Korean. Then, the survey results were again translated into English by the researcher. Two professionals in IT and quantitative analysis reviewed the questionnaire to confirm contents, mutual exclusiveness, and collective exhaustiveness. We performed the pilot study with 10 participants to confirm the measures' validity, simplicity, redundancy, and logical order of questions. Each indicator was measured based on a seven-point Likert-type scale (1 = strongly disagree, 7 = strongly agree). The survey measures with related references are detailed in the appendix.

B. Data

The theoretical framework was empirically tested by the use of data gathered from the online-based survey in May 2022. The online link to the questionnaire was delivered to internet users. The first page of the questionnaire asked respondents about their experiences of using metaverse. Only the respondents who answered that they had experience with using the metaverse passed on to the main contents of the survey. A total of 193 responses were used for data analysis. 101 (52.3%) respondents were male and 92 (47.7%) informants were female. Their ages range from those their 20s to their 50s. Table I presents detailed demographic information of the respondents.

TABLE I. DEMOGRAPHIC CHARACTERISTICS OF THE SAMPLES

Demographics	Item	Subjects (N=193)	
		Frequency	Percentage
Gender	Male	101	52.3%
	Female	92	47.7%
Age	20s	34	17.6%
	30s	36	18.7%
	40s	61	31.6%
	50s	62	32.1%

IV. RESEARCH RESULTS

We analyzed the theoretical framework using the partial least squares (PLS) method with SmartPLS. The PLS has been widely selected as a tool in the IT field [25]. The analysis was carried out in two stages: An evaluation of the reliability, convergent validity, and discriminant validity of the measurement model, and an evaluation of the structural model.

A. Measurement Model

The reliability and validity of the measurements were confirmed in this research. Composite reliability (CR), average variance extraction (AVE), and Cronbach's alpha were investigated to verify the reliability. The dependability was met if the CR and Cronbach's alpha scores were above 0.70 [26,27] and the AVE values were higher than 0.50 [26]. As can be seen in Table II, the CR, Cronbach's alpha, and AVE estimates of the variables were assessed to be above the expected threshold, indicating an appropriate level of reliability. When each question's factor load exceeds 0.70, convergence validity is guaranteed [28]. Convergent validity was attained because all factor loadings were higher than the suggested cutoff (Table II).

TABLE II. RELIABILITY AND VALIDITY OF FACTORS

Construct	Items	Mean	St. Dev.	Factor Loading	Cronbach's Alpha	CR	AVE
Information Security (ISE)	ISE1	3.010	1.063	0.903	0.911	0.944	0.849
	ISE2	2.927	0.984	0.943			
	ISE3	2.865	1.093	0.918			
Utilitarian Benefits (UTB)	UTB1	3.585	0.854	0.881	0.804	0.884	0.718
	UTB2	3.238	1.010	0.828			
	UTB3	3.741	0.798	0.833			
Hedonic Benefits (HEB)	HEB1	3.876	0.824	0.860	0.834	0.901	0.751
	HEB2	3.834	0.842	0.877			
	HEB3	3.891	0.744	0.862			
User Satisfaction (USA)	USA1	3.570	0.739	0.855	0.810	0.887	0.724
	USA2	3.601	0.865	0.890			
	USA3	3.694	0.830	0.805			

Last, the root square of the individual variables' AVE values was compared to their common variances to determine the discriminant validity. Because the square root value of AVE for all components surpasses the correlations, discriminant validity is acceptable [26]. The results of discriminant validity are shown in Table 3.

TABLE III. CORRELATION MATRIX AND DISCRIMINANT ASSESSMENT

Constructs	1	2	3	4
1. Information Security	0.922			
2. Utilitarian Benefits	0.481	0.848		
3. Hedonic Benefits	0.272	0.662	0.867	
4. User Satisfaction	0.514	0.663	0.631	0.851

B. Hypothesis Test

A structural equation modeling (SEM) method was employed to assess the hypothesized paths among the constructs through partial least squares (PLS). This work applied a bootstrapping approach (bootstrapping subsample = 5000) to test the proposed hypothesis and path coefficients. The SEM analysis results are illustrated in Figure 2.
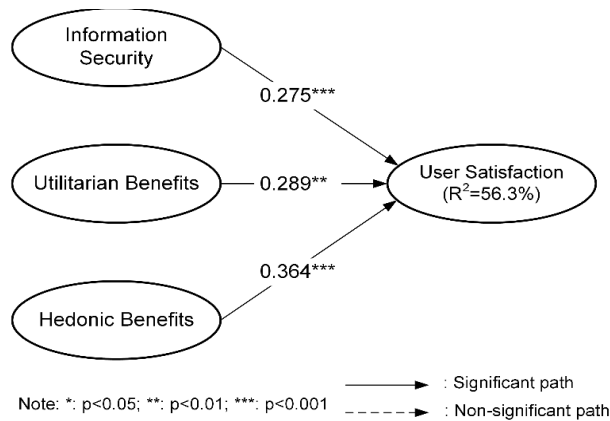

Note: *: p<0.05; **: p<0.01; ***: p<0.001

Figure 2. PLS-SEM Algorithm Results

As expected, information security proved to be the deciding factor of user satisfaction (b=0.275, t=4.402), supporting H1. As suggested, utilitarian benefits are validated to significantly affect user satisfaction (b=0.289, t=3.162), supporting H2. Consistent with prediction, hedonic benefits are revealed to significantly influence user satisfaction (b=0.364, t=4.33), supporting H3. Overall, the analytical model accounted for 56.3 percent of the variability in user satisfaction. Table 4 details the results of PLS-SEM.

TABLE IV. SIGNIFICANCE TESTING RESULTS OF THE STRUCTURAL PATH COEFFICIENTS

H	Cause	Effect	Coefficient	T-value	Hypothesis
H1	ISE	USA	0.275	4.402	Supported
H2	UTB	USA	0.289	3.162	Supported
H3	HEB	USA	0.364	4.330	Supported

V. CONCLUSION

A. Discussion

The purpose of the present study was to investigate the factors affecting user satisfaction. This has been achieved by introducing information security, utilitarian benefits, and hedonic benefits.

The findings verified that information security is significantly associated with user satisfaction. These results are in agreement with outcomes concluded in related works [15,16,18]. One plausible explanation for these findings is the fact that users are more satisfied with metaverse when their information is more secure.

The results found that utilitarian value has a significant influence on satisfaction. A significant correlation between utilitarian benefits and user satisfaction was demonstrated in former research [29,30]. These findings may lie in the reason that the more useful information and help users get from the metaverse, the better their satisfaction.

The analysis uncovered that hedonic benefits are the imperative antecedent factor of user satisfaction. There were some results confirmed in former research [29,31]. These observations lie in the fact that when users feel more fun and enjoyment from the metaverse, they are more satisfied with it.

B. Implications for Theory and Practice

This paper contributes academically and practically in the following respects. First, it makes a new contribution in that it proves the role of information security on user satisfaction. Many users enter their personal information and payment information in the metaverse. Information security is becoming a more important factor. Based on the results of this study, researchers need to identify content that users are particularly sensitive to among various types of information. It would be beneficial for marketers to appeal to customers by emphasizing the security quality of the metaverse.

Second, the current study reflected benefits in a balanced way by dividing them into utility and pleasure. The study results showed that pleasure has greater explanatory power than utility. Therefore, scholars need to further explore which factors in the metaverse mainly drive pleasure. Managers should create customers by underlining the enjoyment that metaverse provides. At the same time, they must mention that metaverse can be a useful tool in users' work environments.

Last, the present study provides a new contribution to the literature in that it performed an empirical behavioral analysis to

identify the satisfaction of metaverse users. Existing studies have mainly focused on ideas, cases, and engineering proposals [32,33]. Now, as the metaverse market grows, more marketing strategies are required. This study provides the necessary implications at present by empirically analyzing user satisfaction.

C. Limitations and Future Research Directions

The limitations of this paper and the corresponding future research directions are as follows. First, this study introduced only information security and benefits as antecedent factors for user satisfaction. The determinants of user satisfaction will be more diverse. Future research can expand the research model by evenly reflecting individual characteristics, social characteristics, and situational characteristics. Second, this study did not reflect the type of metaverse. The satisfaction of users of Metaverse may vary depending on the type. Therefore, it will be meaningful for researchers to illuminate the types of metaverse by classifying them into detailed areas such as games and shopping in the future. Finally, this study has limitations in that it performed a cross-sectional analysis. Consumer satisfaction may be affected by the circumstances of the times. Therefore, future research should empirically identify the satisfaction of metaverse users regularly. This will provide clues to the dynamic structure.

APPENDIX

List of Model Constructs and Items

Information Security is taken from [16].

ISE1: I trust that my personal information will not be used for any other purpose.

ISE2: I believe that my personal information is protected.

ISE3: I'm confident that my personal information is secure.

Utilitarian Benefits are taken from [15,34].

UTB1: Utilizing Metaverse is beneficial.

UTB2: My use of Metaverse is advantageous.

UTB3: I think it's worthwhile to use Metaverse.

Hedonic Benefits are taken derived from [15].

HEB1: It's fun for me to use Metaverse.

HEB2: The Metaverse application itself is entertaining.

HEB3: I find using metaverse to be enjoyable.

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