박사학위논문

Three Essays on Embracing Metaverse

- technology acceptance model, value-based adoption model, expectation confirmation model -

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한 성 대 학 교 대 학 원

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ABSTRACT

Three Essays on Embracing Metaverse
– technology acceptance model, value-based adoption model and expectation confirmation model –

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This dissertation deals with Metaverse acceptance, consisting of three papers comparing how Metaverse characteristics are applied to each of the three acceptance models (Technology Acceptance Model, Value-based Adoption Model, and Expectation Confirmation Model).

In the first essay, an extended technology acceptance model was applied to analyze the factors affecting users' intention to use the metaverse. In other words, the factors affecting users' intention to use the Metaverse were defined as technical characteristics (telepresence, interoperability, seamlessness, concurrence, and economy flow) and personal characteristics (social influence and perceived enjoyment) from the perspective of the Extended Technology Acceptance Model. The results showed that perceived usefulness and perceived ease of use, which

are antecedents of the Extended Technology Acceptance Model, influence the intention to use Metaverse, and perceived ease of use influences perceived usefulness. Telepresence, interoperability and economy flow were found to have a positive effect on perceived usefulness, and interoperability, seamlessness and concurrence were found to have a positive effect on perceived ease of use. In addition, social influence and perceived enjoyment had a positive effect on intention to use the Metaverse.

The second essay used an extended Value-based Adoption Model to analyze the determinants affecting the intention to use Metaverse users. The determinants impacting users' intention to adopt the Metaverse were identified as technical attributes (seamlessness, concurrence, telepresence, interoperability and economy flow) and personal characteristics (self-efficacy and social influence). The results showed that perceived usefulness and perceived enjoyment were found to have a positive influence on perceived value. Meanwhile, technicality and perceived fee did not have a statistically significant negative effect on perceived value. Among the Metaverse characteristics, telepresence, interoperability, concurrence and economy flow were found to have a positive influence on perceived usefulness, and telepresence, interoperability and concurrence were found to have a positive influence on perceived enjoyment. Meanwhile, the NCA results indicate that telepresence, interoperability, and concurrence are necessary conditions for perceived usefulness, while concurrence is the only necessary condition for perceived enjoyment. In addition, we found that social influence and self-efficacy had a positive influence on intention to use the Metaverse.

The third essay empirically analyzed various acceptance factors affecting

the intention to use the metaverse by applying the combination model of the technology acceptance model (TAM) and the expectation confirmation model (ECM). The characteristics of the metaverse were described in telepresence, interoperability, seamlessness, concurrence, and economy flow. The results showed that perceived usefulness and perceived ease of use were positively associated with intention to use. However, perceived ease of use was not positively related to perceived usefulness. On the other hand, expectation confirmation of Metaverse was found to have a positive impact on perceived usefulness, perceived ease of use, and satisfaction with the Metaverse. In addition, perceived usefulness and perceived ease of use were positively associated with satisfaction. Moreover, satisfaction was positively related to intention to use. In addition, this study aims to show how the analysis of net and combinatory effects of Metaverse features can improve the understanding of perceived usefulness and confirmation. The net effects from the SEM show that telepresence, interoperability and economy flow positively relate to perceived usefulness and that the effect of interoperability is stronger. The fsQCA results provide a more nuanced understanding of how these five antecedent conditions affect perceived usefulness and expectation confirmation.

The contributions of this study are as follows. First, because Metaverse research is currently in its infancy, much of the research on Metaverse is conceptual and typological; however, this study provides a foundation for empirical Metaverse research by examining its impact on Metaverse acceptance through actual Metaverse users.
Second, this study aims to investigate the determinants of intention to adopt Metaverse among current users, considering the current stage of Metaverse technology development. The factors influencing

adoption intention are analyzed by categorizing them into two main dimensions: technology characteristics (telepresence, interoperability, seamlessness, concurrence, and economy flow) and personal characteristics (social influence, perceived enjoyment and self-efficacy). Third, while there have been studies on user acceptance of telepresence, interoperability, etc. in existing AR-VR studies, there have been no studies on Metaverse user acceptance of the five Metaverse characteristics used in this study. Fourth, various acceptance models (TAM(Technology, Acceptance Model), VAM(Value-based Adoption Model), ECM(Expectation Confirmation Model)) were used to examine the effect of metaverse characteristics on user acceptance. Fifth, PLS-SEM, a quantitative analysis, was used as a basic analysis methodology, and qualitative methodologies (NCA(Necessary Condition Analysis), QCA(Qualitative Comparative Analysis)) were used to compensate for this. Finally, Based on research results on the impact of Metaverse characteristics (telepresence, interoperability, seamlessness, concurrence, and economy flow) on user intentions, these results are utilized to provide management implications for enterprises to enhance Metaverse services and improve user satisfaction

【Keywords】 telepresence, interoperability, seamlessness, concurrence, and economy flow, TAM(Technology, Acceptance Model), VAM(Value-based Adoption Model), ECM(Expectation Confirmation Model), NCA(Necessary Condition Analysis), QCA(Qualitative Comparative Analysis)

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1.1 Introduction

In the past few years, the global pandemic and the development of virtual reality and augmented reality technologies have led to a metaverse craze, where various interactions and transactions are possible in a virtual world (Yun et al., 2023). Metaverse is a combination of virtual and transcendent (Meta) and world and universe (Universe), which means 'hyper-connected and hyper-realistic digital world'. In other words, it is a digital environment that is free from the physical and functional constraints of the space we live in (Kim, 2021).

In the Korean government's 'Strategy for the Development of Virtual Convergence Economy', Metaverse was introduced as an innovation tool to overcome the economic crisis, and it was stated that the virtual convergence economy that creates new value is rapidly emerging due to the significant expansion of XR (eXtended Reality) technology, which includes Augmented Reality and Virtual Reality (Ministry of Science and ICT, 2021). In its report 'Seeing is Believing', PwC Consulting (2020) said that the VR and AR market,

* This essay was published in Kim and Lee (2023). A study of the impact of Metaverse attributes on intention to use - based on the Extended Technology Acceptance Model. Journal of Intelligence and Information Systems, 29(2), 149-170.

which constitute sub-technologies of the Metaverse, will grow to KRW 537 trillion in 2025 and KRW 1,700 trillion in 2030. In fact, the daily users of the Metaverse game service Roblox increased by 171% from 15.4 million in the first quarter of 2019 to 41.8 million in the first quarter of 2021, the monthly users of Minecraft increased by 250% from 40 million in June 2016 to 140 million in April 2021, and the global cumulative users of Zepeto, a representative Metaverse service in Korea, exceeded 200 million (Jung, 2021).

In the meantime, while the growth momentum has been centered on VR and AR for many years, collectively referred to as XR technology, including new technologies that will appear in the future such as virtual reality (VR), augmented reality (AR), and mixed reality (MR), the concept and business model of the Metaverse has gained attention in 2021, securing new growth momentum and evolving into XR technology (Park, 2021).

While interest in the Metaverse is growing rapidly around the world, there is no guarantee that the Metaverse will lead to widespread consumer acceptance. As we have already seen in the case of 3D TV, smart TV, and video phone, new media may face consumer rejection, and popularization may be delayed from the initial prediction. Therefore, in order for the Metaverse to succeed in popularization through the process of acceptance and adoption without facing consumer rejection, research is needed to predict and analyze factors that affect consumer acceptance.

Most of the existing studies are related to services using virtual reality (VR) and augmented reality (AR) technologies, which are

sub-concepts of XR (Lee et al. 2021; Hong & Han, 2020; Jeon & Nam, 2020), or studies on the conceptual definition and typology of Metaverse (Ko et al., 2021; Lee, 2021; Seok, 2021), and studies on the intention to continue using Metaverse services based on virtual reality (XR) technology are lacking. Therefore, this study aims to investigate the intention to continue using Metaverse services based on the Extended Technology Acceptance Model (TAM). In addition, this study aims to provide implications by deriving factors that affect the intention to continue using Metaverse services that are different from virtual reality (VR) and augmented reality (AR) services.

1.2 Conceptual framework and Hypothesis

1.2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), first proposed by Davis (1989), is a model based on the theory of reasoned action to predict an individual's acceptance of an innovative technology.
TAM uses the theory of reasoned action as a theoretical basis to specify the causal relationship between users' attitudes, intentions, and actual computer acceptance behavior through the two main antecedents of TAM, perceived usefulness and perceived ease of use. Although TAM is less general than the theory of reasoned action because it is designed to apply only to computer use behavior, it may be more appropriate for modelling computer acceptance because it incorporates accumulated findings from information systems research (Davis et al., 1989).

TAM theorizes that an individual's behavioral intention to adopt an information system is determined by two beliefs. Perceived usefulness

is defined as "the extent to which an individual perceives that using a particular information technology can improve his or her job performance" and perceived ease of use is defined as "the extent to which an individual expects to use a particular information technology easily and without much mental and physical effort". Perceived ease of use has a direct effect on perceived usefulness and technology use.

Although the original theoretical concept of TAM included attitude, the final model of TAM (Davis, 1989) excluded attitude by showing that attitude only partially mediated the effect of perceived usefulness on intention, and that the direct relationship between perceived usefulness and attitude was weak, but the direct relationship between perceived usefulness and intention to use was strong. The removal of attitude allows for a better understanding of the effects of perceived usefulness and perceived ease of use on the main dependent variable, intention (Venkatesh & Davis, 2000). Therefore, the hypothesis of the Metaverse based on the refined Technology Acceptance Model (TAM) is as follows.

H1. Perceived ease of use will positively influence perceived usefulness.
H2. Perceived usefulness will have a positive effect on intention to use the Metaverse.
H3. Perceived ease of use will have a positive effect on intention to use the Metaverse.

1.2.2 Metaverse Attributes

Although expressed in different terms by different researchers, the main characteristics of a Metaverse are not significantly different between them. Kim & Shin (2021) presented a SPICE model of the main characteristics of a Metaverse based on ASF, which are Seamlessness, Presence(Telepresence), Interoperability, Concurrence, and Economy Flow. Based on the summary by Kim & Shin (2021), the characteristics of the Metaverse are as follows.

1.2.2.1 Telepresence

Telepresence can be described as the feeling of being in a real environment (Davis et al., 2009) or the concept of being connected not only to an avatar but also to other digital spaces and environments in real life (Tasa & Görgülü, 2010). This is because it is important for platforms to create a similar experience in order to enhance the sense of immersion in an environment that the user does not have physical contact with (Kim et al., 2022)

Lee et al. (2021) presented factors affecting intention to use VR-based digital content subscription services, and found that among the characteristics of VR content, presence had a positive effect on both perceived usefulness and perceived enjoyment. Han & Ahn (2019) verified that telepresence affects enjoyment and usefulness in a distribution environment using VR technology, which in turn affects future intention to use VR. In their study, Na & Li (2021) described the extrinsic factors that influence the intention to use of mobile learning applications by users and found that the two variables of telepresence and interoperability had positive significant effects on both perceived usefulness and perceived ease of use. On the other hand, Na & Wui's (2019) study hypothesized a positive relationship

between telepresence and perceived ease of use, but their analysis showed no positive relationship, suggesting that telepresence does not affect perceived ease of use for VR games. In order to confirm the findings of the other analyses, we would like to test the hypothesis in this study.

H4: Telepresence will have a positive impact on perceived usefulness.

H5: Telepresence will have a positive impact on perceived ease of use.

1.2.2.2 Interoperability

Interoperability refers to a situation where data and information in the real world and the Metaverse are interconnected, so that the results of the user's experiences and actions in the Metaverse are connected to the real world, and the experience in the Metaverse becomes richer and more convenient based on lifelogging information in the real world. This is because even if online information is abundant, if the information is distant from the real world or if the information between users moves independently, the immersion of the platform is bound to decrease (Koo et al., 2021).

The higher a user perceives interoperability within a particular system, the more influential it is in shaping positive attitudes towards the technology (McMillan & Hwang, 2002). In a related study, Park & Nam (2017) measured the effect of perceived interoperability on information acceptance in a mobile health information service and found that higher perceived interoperability positively influenced perceived usefulness and perceived ease of use, leading to higher

intention to use. Cha (2019) suggested that interoperability is a factor that must be increased in the case of interactive content because it acts as an instrumental device that makes active users more immersed in the content and applied the technology acceptance model to verify the acceptance of theatre advertisements through NFC technology and found that interoperability positively enhances perceived usefulness and perceived ease of use. The Na & Li (2021) study described the external factors affecting mobile learning application users' intention to use, and it was found that two variables, telepresence and interoperability, had a positive and significant effect on both perceived usefulness and perceived ease of use.

H6: Interoperability will have a positive impact on perceived usefulness.

H7: Interoperability will have a positive impact on perceived ease of use.

1.2.2.3 Seamlessness

Seamlessness can be described as the concept of whether a digital environment continues to function even when the user is not connected to it (Gilbert, 2011). For example, Fortnite allows users to play a battle royale-style game on one platform and then move directly to a party royale space to watch a performance, or to a community space to interact with others. What's important here is that you're not just able to do different things on one platform, but that your history is also linked. Rather than new connections and different characters in different places, it's the continuity that

connects memories and information, just as we do in real life (Koo et al., 2021).

H8: Seamlessness will have a positive impact on perceived usefulness.

H9: Seamlessness will have a positive impact on perceived ease of use.

1.2.2.4 Concurrence

Concurrence is the idea that a platform should be accessible to multiple users at the same time. It refers not only to connecting avatars in virtual reality, but also to another level, from real life to other digital spaces and environments (Tasa & Görgülü, 2010), which means that a large number of users in remote physical locations can interact simultaneously (Gilbert, 2011). In the real world, people do not create and expand information alone, but rather in large groups to share a variety of information. From this perspective, for a platform to be valuable, it must first have a large number of users (Kim et al., 2022).

H10: Concurrence will have a positive impact on perceived usefulness.

H11: Concurrence will have a positive impact on perceived ease of use.

1.2.2.5 Economy Flow

Economy Flow is the concept of whether the products or services present on the platform can be traded. It can be categorized into types that can be consumed anywhere regardless of where they are

made, such as offline products being consumed online, products made online being consumed online, or online products being consumed offline (Guo & Chow, 2008). This diversity of transactions can increase the time spent immersed in the platform. For example, in gaming, users may need various items to customize their character or level up their character, and they may not be able to achieve their goals through in-platform activities alone, so they may use real money to help them. In this respect, it is important to be able to trade within the platform for elements that can make the user stand out in the Metaverse or provide convenience, which will increase sustainable use (Kim et al. 2022).

H12: Economy Flow will have a positive impact on perceived usefulness.

H13: Economy Flow will have a positive impact on perceived ease of use.

1.2.3 Individual Attributes

1.2.3.1 Social influence

Social influence refers to the influence of the opinions of one's peers on personal behavior. Influence Theory suggests that consumers tend to follow the opinions of those around them that they perceive as important. In particular, when individuals have insufficient information or lack certainty, they adopt behavior through the process of internalization, which is the process of establishing their own opinions with the help of others (Deutsch & Gerard, 1955).

Yang and Choi (2001) studied students' acceptance of spreadsheets and the Internet by applying the Technology Acceptance

Model and found that social influence, including subjective norms and social image, is a significant predictor of technology acceptance (Yang & Choi, 2001). Social influence was found to have a static effect on perceived usefulness and intention to use the Metaverse (Oh, 2021).

H14: Social influence will have a positive effect on intention to use the Metaverse.

1.2.3.2 Perceived enjoyment

Perceived enjoyment refers to the perception that using a new technology is enjoyable in and of itself, regardless of whether or not it achieves a goal. Perceived enjoyment, the degree of pleasure and satisfaction in using a new information technology, is described as an important external variable in the TAM (Park & Hyun, 2013).

Venkatesh & Morris (2000) also described playfulness as an important factor influencing users' acceptance of new technologies, and a study by Qiao & Han (2019) found that perceived enjoyment of virtual reality content positively influenced intention to reuse. There are also studies that show that the fun factor of SNS influences perceived usefulness and intention to continue using (Cho, 2017). In this context, fun and enjoyment in using new media can be seen as a positive influence on acceptance of the media (Park & Hyun, 2013).

H15: Perceived enjoyment will have a positive effect on intention to use the Metaverse.

The following conceptual framework is formed 〈Figure 1-1〉.

〈Figure 1-1〉 Conceptual framework

1.3 Methods

1.3.1 Sample

Since the technical and personal characteristics of the Metaverse platform are related to the acceptance of the Metaverse, the survey required for this study needs to target people with experience using the Metaverse platform as much as possible, so the quota sampling method by gender and age was used.

The survey for the study was conducted with the support of online research agency Embrain over a two-day period from 6th to 7th February 2023. A total of 327 responses were collected through quota sampling by gender and age from the research firm's online panel of people who have used the Metaverse platform at least once, including men and women aged 14 to 64 years old living in Korea. 〈Table 1-1〉 shows the demographic profile of the participants.

The demographic characteristics of the sample used in this study are shown in 〈Table 1-1〉. The average age of the sample was 31, with 76 (23.2%) in their teens and younger, 83 (25.4%) in their 20s, 82 (25.1%) in their 30s, and 86 (26.3%) in their 40s and older, and 159 (48.6%) males and 168 (51.4%) females.

The purpose of using the Metaverse was more likely to be for enjoyment and fun (271, 82.9%) than for exploring/learning new information (56, 17.1%).

Of the respondents, 115 (35.2%) use Minecraft as their primary Metaverse platform, followed by 75 (22.9%) for ZEPETO, 61 (18.7) for Animal Crossing, 51 (15.6%) for Roblox, 12 (3.7%) for Gather Town, 12 (3.7%) for Ifland, and 1 (0.3%) for Fortnite.
In addition, 37 (11.3%) of the respondents use the Metaverse platform almost daily, 71 (21.7%) use it every 2-3 days, 69 (21.1%) use it once a week, 45 (13.8%) use it every 2-3 weeks, and 105 (32.1%) use it once a month or less.

〈Table 1-1〉 Sample description (N = 327).

Construct		Frequency(N)	Percent(%)
Gender	Female	168	51.4
	Male	159	48.6
Age	~19	76	23.2
	20~29	83	25.4
	30~39	82	25.1
	40~	86	26.3
Purpose of using Metaverse	Utilitarian	56	17.1
	Hedonic	271	82.9
Preferred	Minecraft	115	35.2

Metaverse Platforms	ZEPETO	75	22.9
	Animal Crossing	61	18.7
	Roblox	51	15.6
	Gather Town	12	3.7
	Ifland	12	3.7
	Fortnite	1	0.3
Frequency of using Metaverse	Almost every day	37	11.3
	Once every 2-3 days	71	21.7
	Once a week	69	21.1
	Once every 2-3 weeks	45	13.8
	Once a month or less	105	32.1

1.3.2 Measurement

The variables in the study are five independent variables representing Metaverse characteristics (Telepresence, Interactivity, Seamlessness, Concurrence, and Economic flow), two independent variables representing individual characteristics (Social Influence, Perceived Enjoyment), two parameters (Perceived Usefulness, Perceived Ease of Use), and the dependent variable (Intention to use) are 10 in total, and are operationally defined as shown in 〈Table 1-2〉 based on previous studies.

〈Table 1-2〉 Operational definition of variables

Construct	Operational Definition	Related studies
Tele-presence	Perceived psychological identification in the context of using Metaverse services	Kim et. al.(2022), Davis et al.(2009), Dionisio et al.(2013), Gilbert(2011), Guthrie et. al.(2011), Noor(2010)
Inter-operability	The extent to which data and information on the Metaverse platform interoperates with the real world when accessed by users	Kim et. al.(2022), Cammack(2010), Davis et al.(2009), Dionisio et al.(2013), Noor(2010), Tasa and Görgülü(2010)
Seam-lessness	The extent to which the Metaverse continues to function even when users are not connected to the digital environment.	Kim et. al.(2022), Gilbert(2011), Tasa and Görgülü(2010), Guthrie et al.(2011), McKerlich et al.(2011), Noor(2010)

Con-currence	The extent to which multiple users can simultaneously access the Metaverse platform	Kim et. al.(2022), Cammack(2010), Gilbert(2011), Guthrie et al.(2011), McKerlich et al.(2011)
Economy flow	The extent to which users can trade products or services that exist on the Metaverse platform.	Kim et al.(2022), Cammack(2010)
Social Influence	The extent to which your use of the Metaverse is influenced by the people around you	Son et al (2014), Oh (2021), Park & Kang (2021)
Perceived Enjoyment	The extent to which using the Metaverse is perceived as enjoyable or fun.	Kim et al. (2007), Park & Byun (2013), Oh (2021), Park& Kang (2021)
Perceived Usefulness	The extent to which Metaverse use is perceived to be useful in improving quality of life compared to before	Qiao & Han (2019), Oh (2021), Park& Kang (2021)
Perceived ease of use	The degree to which a Metaverse is perceived as easy and convenient to use	Qiao & Han (2019), Oh (2021), Park& Kang (2021)
Intention to use	The intention or plan to continue using the Metaverse service in the future	Davis et al. (1989), Venkatesh et al. (2003)

1.3.3 Data Analysis

In this study, partial least squares (PLS) path modelling was used to estimate the relationships hypothesized in this model. There are two approaches to specify or test hypothesized relationships in path analysis (Hair et al., 2010): covariance-based structural equation modeling (CB-SEM) and PLS-SEM. CB-SEM uses a maximum

likelihood estimation (MLE) procedure to estimate model coefficients "so that the discrepancy between the estimated and sample covariance matrices is minimized" (Hair et al., 2014, p. 27). CB-SEM is more suitable for confirming or rejecting a developed theory. Conversely, PLS-SEM estimates model parameters in a way that maximizes the variance explained in endogenous variables and is preferred for research aimed at theory development and prediction (Hair et al., 2014, p. 14).

PLS path modeling is also recommended over CB-SEM for testing complex models with many latent variables (Henseler et al., 2009). Compared to the average number of 4.4 latent variables in a CB-SEM (Shah & Goldstein, 2006), the proposed model in our study has 10 latent variables. In addition, the purpose of this study is to examine the impact of Metaverse attributes on intention to use, which is concerned with exploring a potentially new theoretical framework rather than confirming or validating established theories. For these reasons, a PLS path modeling approach is more appropriate for data analysis in the this study. According to Hair et al. (2017), a rough estimate of the sample size can be calculated as 10 times the number of variables included in the analysis, which is known as the 10-fold rule. According to this rule, the number of constructs in this study is 10 and the number of structural path is 15, so only 150 samples are needed, but 327 samples are sufficient for this study.

Although PLS-SEM works efficiently with small sample sizes, previous studies have shown that it is possible to use PLS-SEM with a relatively large sample size (N=851) (Anderson & Swaminathan, 2011). Anderson and Gerbing (1988) proposed the two-stage

methodology in which the measurement model was first validated and in the second stage, the bootstrapping technique was used to test hypotheses.

1.4 Results

1.4.1 Measurement Validation

Internal consistency, convergent validity, and discriminant validity were analyzed to test the measurement model. The Mean, Standard Deviation, and Loadings of all the constructs in the study are shown in 〈Table 1-3〉. Convergent validity shows "how different measures relate to the same conceptual construct" (Dinev & Hart, 2004, p. 417). 〈Table 1-4〉 shows that all ten constructs met the required thresholds as the loading values were above 0.7, Composite Reliability was above 0.7 and Average Variance Extracted exceeded 0.5 (Hair et al., 2014). The value of Cronbach's Alpha to determine internal consistency was also greater than 0.7 (Fornell & Larcker, 1981). Thus, the convergent validity of the constructs was established.

The Fornell-Larcker criteria was examined to test the discriminant validity. Discriminant validity indicates "the extent to which the measure is adequately discriminated from related constructs within the nomological net" (Dinev & Hart, 2004, p. 417). 〈Table 1-5〉 shows that the square roots of the mean variances extracted from construct are higher than the correlation values on the left and bottom, respectively, satisfying the Fornell-Locker criterion(Fornell & Larcker, 1981; Huh & Lee, 2022).

Next, the R^2 (Adjusted R^2) value (Coefficient of determination) was evaluated. Metaverse attributes represented 50.0%(49.0%) of the explained variance for Perceived Usefulness and 23.7%(22.5%) of the explained variance for Perceived Ease of Use. Also, Perceived Usefulness, Perceived Ease of Use, Social Influence and Perceived Enjoyment represented 61.6%(61.1%) of the explained variance for Intention to Use.

〈Table 1-3〉 Mean, SD, and loadings of constructs

Construct	Item	Mean	SD	Loading
Telepresence	Tel1	2.939	0.981	0.825
	Tel2	2.896	1.062	0.886
	Tel3	2.612	1.016	0.833
Interoperability	Int1	3.287	0.862	0.806
	Int2	3.401	0.865	0.839
	Int3	3.492	0.867	0.840
	Int4	3.394	0.919	0.808
Seamlessness	Seam1	3.144	0.871	0.747
	Seam2	2.862	0.940	0.763
	Seam3	3.229	0.902	0.743
	Seam4	2.966	0.952	0.851
Concurrence	Con1	3.502	0.793	0.805
	Con2	3.318	0.855	0.799
	Con3	3.657	0.816	0.806
Economy flow	EF1	3.248	0.822	0.891
	EF2	3.217	0.845	0.843
	EF3	3.278	0.834	0.863
Social Influence	SI1	2.758	0.977	0.794
	SI2	3.263	0.911	0.815
	SI3	2.676	1.080	0.806
Perceived Enjoyment	PE1	3.517	0.853	0.835
	PE2	3.474	0.859	0.870
	PE3	3.630	0.794	0.870
	PE4	3.602	0.828	0.807
Perceived Usefulness	PU1	3.086	0.911	0.808
	PU2	3.242	0.867	0.775
	PU3	3.468	0.887	0.798
	PU4	3.266	0.867	0.812

Perceived Ease of Use	PEU1	3.547	0.784	0.834
	PEU2	3.45	0.837	0.836
	PEU3	3.367	0.919	0.808
	PEU4	3.404	0.93	0.801
Intention to Use	IU1	3.538	0.823	0.889
	IU2	3.336	0.862	0.900
	IU3	3.177	0.895	0.864

〈Table 1-4〉 Cronbach's Alpha, composite reliability, and average variance extracted of constructs

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Telepresence	0.806	0.885	0.721
Interoperability	0.842	0.894	0.678
Seamlessness	0.785	0.859	0.604
Concurrence	0.726	0.845	0.645
Economy flow	0.839	0.900	0.750
Social Influence	0.730	0.847	0.648
Perceived Enjoyment	0.867	0.910	0.716
Perceived Usefulness	0.810	0.876	0.638
Perceived Ease of Use	0.838	0.891	0.672
Intention to Use	0.861	0.915	0.782

〈Table 1-5〉 Discriminant validity - Fornell-Larcker criterion

	1	2	3	4	5	6	7	8	9
Concurrence	**0.803**								
Economy flow	0.505	**0.866**							
Intention to Use	0.481	0.382	**0.884**						
Interoperability	0.643	0.475	0.546	**0.823**					
Perceived Ease of Use	0.457	0.225	0.498	0.376	**0.820**				
Perceived Enjoyment	0.503	0.344	0.688	0.516	0.421	**0.846**			
Perceived Usefulness	0.522	0.445	0.677	0.621	0.410	0.667	**0.798**		
Seamlessness	0.297	0.117	0.114	0.157	0.242	0.080	0.108	**0.777**	
Social Influence	0.375	0.396	0.512	0.426	0.315	0.349	0.540	0.202	**0.805**
Telepresence	0.436	0.356	0.533	0.496	0.280	0.492	0.525	0.265	0.483

1.4.2 PLS Path Modeling and Hypotheses Testing

Before the structural model evaluation, multicollinearity must be checked to ensure valid results. The Variance Inflation Factor (VIF) values were below 5, between 1.363 to 2.482, implying the absence of multicollinearity in the model (Hair & Lukas, 2014). Next, the structural model was evaluated by the bootstrapping method (5,000 resamples) to check the significance of the hypotheses 〈Table 1-6〉.

〈Table 1-6〉 Results of hypothesis testing

Hypo.	Path	β	s.e.	t-value	p-value	Result
H1	Perceived Ease of Use -> Perceived Usefulness	0.169	0.058	2.902	0.004	Supported
H2	Perceived Usefulness -> Intention to Use	0.248	0.06	4.148	0.000	Supported
H3	Perceived Ease of Use -> Intention to Use	0.175	0.042	4.128	0.000	Supported
H4	Telepresence -> Perceived Usefulness	0.256	0.048	5.363	0.000	Supported
H5	Telepresence -> Perceived Ease of Use	0.051	0.069	0.736	0.462	Not Supported
H6	Interoperability -> Perceived Usefulness	0.331	0.051	6.517	0.000	Supported
H7	Interoperability -> Perceived Ease of Use	0.139	0.075	1.858	0.063	Supported
H8	Seamlessness -> Perceived Usefulness	-0.092	0.064	1.432	0.152	Not Supported
H9	Seamlessness -> Perceived Ease of Use	0.113	0.056	2.036	0.042	Supported
H10	Concurrence -> Perceived Usefulness	0.083	0.068	1.214	0.225	Not Supported
H11	Concurrence -> Perceived Ease of Use	0.332	0.077	4.294	0.000	Supported
H12	Economy flow -> Perceived Usefulness	0.127	0.053	2.427	0.015	Supported
H13	Economy flow -> Perceived Ease of Use	-0.040	0.069	0.581	0.561	Not Supported
H14	Social Influence -> Intention to Use	0.189	0.05	3.797	0.000	Supported
H15	Perceived Enjoyment -> Intention to Use	0.383	0.062	6.183	0.000	Supported

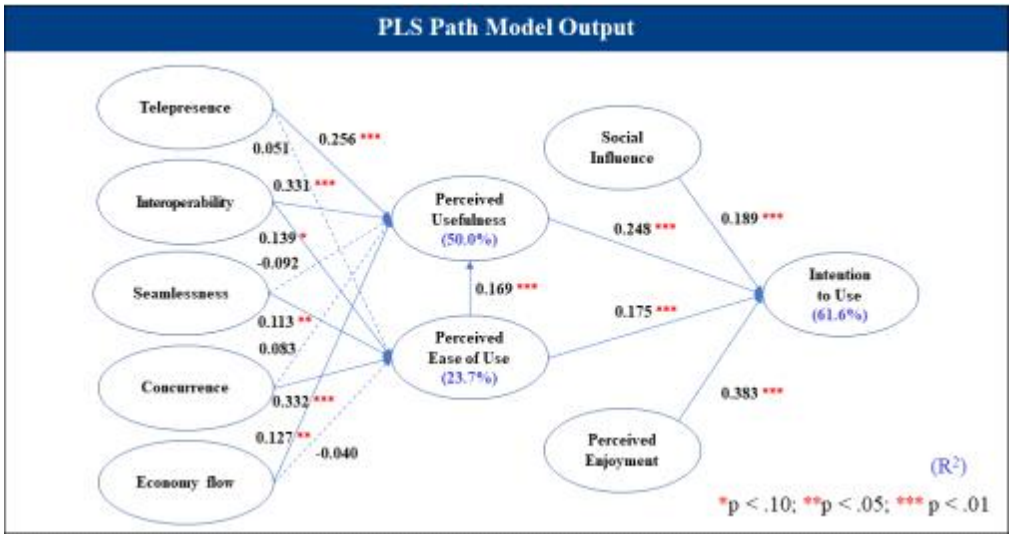
All hypotheses related to TAM were supported. Hypothesis 1 was supported, revealing that Perceived Ease of Use (β =.169, t=2.902, p=.004) was positively associated with Perceived Usefulness. Hypothesis 2 and 3 were supported, indicating that Perceived Usefulness (β =.248, t=4.148, p=.000) and Perceived Ease of Use (β =.175, t=4.128, p=.000) were positively related to Intention to Use.

Hypotheses about the effects of Metaverse characteristics on Perceived Usefulness and Perceived Ease of Use were partially supported and partially rejected. The results show that Telepresence was positively associated with Perceived Usefulness (β =.256, t=5.363, p=.000), but was not positively associated with Perceived Ease of Use (β =.051, t=0.736, p=.462). Interoperability had a significant effect on Perceived Usefulness (β =.331, t=6.517, p=.000) and Perceived Ease of Use (β =.139, t=1.858, p=.063). Meanwhile, Seamlessness (β =.113, t=2.036, p=.042) and Concurrence (β =.332, t=4.294, p=.000) were positively related to Perceived Ease of Use but Seamlessness (β =−.092, t=1.432, p=.152) and Concurrence (β =.083, t=1.214, p=.225) were not positively related to Perceived Usefulness. On the other hand, Economy Flow had a significant effect on Perceived Usefulness (β =.127, t=2.427, p=.015), but not on Perceived Ease of Use (β =−.040, t=0.581, p=.561). Therefore, H4, H6, H7, H9, H11 and H12 were supported but H5, H8, H10 and H13 were not supported.

Meanwhile, Hypothesis 14 and 15 were supported, indicating that Social Influence (β =.189, t=3.797, p=.000) and Perceived

Enjoyment (β =.383, t=6.183, p=.000) were positively related to Intention to Use.

〈Figure 1-2〉 Partial Least Squares (PLS) Output



1.5 Conclusion

1.5.1 Discussion

This study examines the factors that influence the intention to use Metaverse by applying the Extended Technology Acceptance Model (ETAM). Since the pandemic, Metaverse platforms have started to proliferate. They have leveraged the strength of the technologies such as virtual reality (VR) and augmented reality (AR), which allow interaction among people in the three-dimensional virtual world(Kim, 2022). However, new platform such as Metaverse does not necessarily lead to diffusion through user acceptance and adoption.

This is because popularization may be delayed due to user rejection and innovation resistance (Choi et al., 2017). Therefore, in order for new platform such as Metaverse to be stably accepted and diffused, it is necessary to explore and analyze the acceptance factors that determine users' intention to use Metaverse from the initial stage of acceptance and diffusion.

This study empirically analyzed various acceptance factors affecting the intention to use the Metaverse by applying the Extended Technology Acceptance model (EATM), i.e., the factors affecting the intention to use the Metaverse were set as Metaverse characteristics such as Telepresence, Interoperability, Seamlessness, Concurrence, and Economy Flow and personal characteristics such as Social Influence and Perceived Enjoyment, and were tested through a structural model. The results are as follow.

First, Perceived Ease of Use was found to have a positive effect on Perceived Usefulness. These results suggest that the more people perceive the Metaverse as easy to use, the more useful they find it to them. In addition, Perceived Usefulness and Perceived Ease of Use were found to have a positive effect on the intention to use the Metaverse. It was found that the attitude was formed and the intention to use it increased.

Second, among the Metaverse characteristics, Telepresence, Interoperability and Economy Flow were found to have a positive impact on Perceived Usefulness, and Interoperability, Seamlessness and Concurrence were found to have a positive impact on Perceived Ease of Use.

Telepresence had a positive effect on perceived usefulness, which is consistent with previous studies (Lee et al., 2021; Han & Ahn, 2019; Na & Li, 2021; Na & Wui, 2019), while telepresence did not have a significant effect on perceived ease of use, which is consistent with the findings of Na & Wui (2019). In other words, higher telepresence can enhance the perceived usefulness of the metaverse, it may not necessarily lead to an equally strong increase in the perceived ease of use. Higher telepresence often involves more immersive and realistic experiences, which can increase the cognitive load on users. These experiences might be more engaging and useful, but they could also be more complex and potentially less user-friendly. The increased sensory input and the need to navigate a more realistic virtual environment might make the metaverse feel less easy to use.

Interoperability had a positive effect on perceived usefulness and perceived ease of use, which is consistent with previous studies (Park & Nam, 2017; Cha, 2019; Na & Li, 2021). Interoperability, which allows the Metaverse platform to interact with other systems, technologies, or virtual worlds, contributes to a more integrated and streamlined user experience. Users can access a wider range of content and experiences with ease. This positively impacts their perceived ease of use as it simplifies their interactions with the platform. In additon, interoperability often means that users can access a diverse set of content, applications, and services from various sources. This variety and richness of offerings enhance the perceived usefulness of the platform. Users can find more valuable and relevant content, contributing to their overall satisfaction.

Economy Flow is the concept of whether the products or services present on the platform can be traded. Economy flow had positive results for perceived usefulness, but not for perceived ease of use. This may be due to the fact that having an economy flow makes the Metaverse platform more useful to use, but it also makes it more complex to use, which is why it does not have a positive effect on perceived ease of use.

Seamlessness can be described as the concept of whether a digital environment continues to function even when the user is not connected to it (Gilbert, 2011). Seamlessness had a positive effect on Perceived Ease of Use, but not on Perceived Usefulness. In other words, a seamless user experience can enhance the perceived ease of use by making interactions with the metaverse straightforward and efficient. However, its effect on perceived usefulness may be less direct, as the value users derive from the metaverse is influenced by various factors, including the specific tasks being performed and users' individual preferences and expectations.

Concurrence is the idea that a platform should be accessible to multiple users at the same time. It turns out that the more concurrency you have, the easier it is to use the Metaverse platform.

Concurrence is the concept that multiple users should be able to access the Metaverse platform at the same time. Concurrence affected perceived ease of use, but not perceived usefulness.

The positive effect of "Concurrence" on "Perceived Ease of Use" implies that the ability for multiple users to access the Metaverse simultaneously creates a more user-friendly environment. It might

mean that users find the platform easy to navigate and interact with when they can engage with others concurrently.

The fact that "Concurrence" doesn't significantly affect "Perceived Usefulness" indicates that while users appreciate the convenience of concurrent access, it doesn't inherently make the platform more useful to them. It might imply that "Concurrence" is more of a baseline expectation for Metaverse platforms, and its presence doesn't necessarily enhance the platform's overall utility.

Third, we found that Social Influence had a positive effect on Intention to Use the Metaverse. These results suggest that the more positive the perception of the Metaverse by the people they care about, the more socially influenced they are to believe that the Metaverse is useful to them, and the more they intend to use the Metaverse. In addition, Perceived Enjoyment had a static effect on the Intention to Use the Metaverse. These results suggest that the more fun and enjoyment people have with the Metaverse, the more they perceive the Metaverse to be useful and accessible to them.

1.5.2 Theoretical and managerial implications

The theoretical implications of this study are as follows.

First, this study examined the factors affecting the intention to accept the technology by subdividing the factors into technology characteristics (telepresence, interoperability, seamlessness, concurrence, and economic flow) and personal characteristics (social influence and perceived enjoyment) among actual Metaverse users at the current stage of Metaverse technology growth.

Second, as Metaverse research is currently in its infancy, most of the studies conducted are conceptual and typological studies of Metaverses. However, this study provides a basis for empirical Metaverse research by examining the impact of adopting Metaverse technology through actual Metaverse users.

Third, there have been studies on user acceptance of telepresence and interoperability as characteristics in existing AR and VR studies, but there are no studies on user acceptance of the five different Metaverse characteristics used in this study, which makes it different.

The results of this study provide direction on which technical aspects of the Metaverse should be further enhanced at the enterprise level. A successful Metaverse strategy should be designed to provide an engaging, immersive, and social experience that satisfies users' needs for telepresence, interoperability, and economy flow, while also being seamless, easy to use, and enjoyable.

First, to enhance telepresence, the Metaverse platform should provide high-quality graphics and audio, as well as intuitive controls that allow users to interact with the virtual world in a realistic way. This could include features such as haptic feedback, VR and AR integration, and realistic physics simulation.

Second, to improve interoperability, the platform should allow users to interact seamlessly with other users and applications across different devices and platforms. This could include the development of open standards and APIs that enable the sharing of data and content between different applications and platforms.

Third, to facilitate a smooth economy flow, the platform should provide a robust and transparent economic system that allows the exchange of virtual goods and services. This could include the development of a virtual currency and marketplace, as well as tools for creating and selling user-generated content.

Fourth, to improve the perceived ease of use, the platform should be designed to provide a seamless and intuitive user experience. This could include features such as contextual help and guidance, as well as automated processes that reduce the need for manual intervention.

Fifth, to promote concurrence, the platform should provide tools and incentives for users to collaborate and compete with each other. This could include features such as multiplayer games, virtual events, and social networking tools that encourage users to interact and engage with each other.

Sixth, to increase the intention to use the Metaverse, the platform should leverage social influence by providing social networking tools and features that allow users to connect and engage with each other. This could include features such as user profiles, friend lists, and group chat.

Finally, the platform should be designed to provide a fun and enjoyable experience for users. This could involve the development of engaging and immersive content, as well as features like achievements, rewards, and leaderboards that encourage users to explore and engage with the virtual world.

1.5.3 Limitations and future research

This section lists a few limitations of this study that should be taken into consideration.

First, since the sample was composed of users who have used the Metaverse platform, it would be meaningful to study adoption resistance among non-users of the Metaverse platform in the future.

Second, although the dependent variable of this study was the intention to use Metaverse, it would have been a better study if the intention to continue using Metaverse was additionally asked since it was a survey of Metaverse users.

Third, this study was conducted based on the technology acceptance model, but in future studies, it would be more useful to conduct additional verification work using various acceptance models such as value-based adoption model and expectation confirmation model.

Fourth, the Metaverse has a variety of technical characteristics, including telepresence, interoperability, seamlessness, concurrence, and economy flow, and personal characteristics, including social influence and perceived enjoyment, but this study covered only five technical factors and two personal factors by synthesizing previous studies on technology acceptance models and the characteristics of the Metaverse. Therefore, if future studies verify the influence relationship between various factors considering the unique characteristics of the Metaverse, it will provide more useful implications for the development of Metaverse technology.

Chapter 2. Investigating the Impact of Metaverse Characteristics on User Behavior through the Combination of PLS-SEM and NCA within the Extended Value-Based Adoption Model*

2.1 Introduction

As the coronavirus pandemic hits the world and physical interaction becomes difficult, people are looking for services that allow them to have a reality-like experience online, and for this reason, the metaverse is attracting attention as a next-generation platform that connects SNS in the post-coronavirus era. The term "Metaverse" refers to a digitally constructed environment that combines elements of virtual reality and transcendence, denoted by the prefix "Meta," with the concepts of a world and universe, represented by the term "Universe." This amalgamation results in a hyper-connected and hyper-realistic digital world. In essence, the concept refers to a virtual setting that transcends the limitations imposed by the physical and functional aspects of our tangible surroundings (Kim, 2020; Kim & Lee, 2023). In the future, users are expected to spend more time in the Metaverse ecosystem, and the transition to a Metaverse ecosystem where various social, economic,

* This essay was published in Kim and Lee (2023). Investigating the Impact of Metaverse Characteristics on User Behavior through the Combination of PLS-SEM and NCA within the Extended Value-Based Adoption Model. Korean Management Review, 52(5), 1159~1191

and cultural activities are connected or converged with the virtual world is expected to accelerate. With the prospect of the Metaverse, a virtual digital ecosystem beyond the real world, becoming a future engine of growth, various industries are predicting the possibility of innovative change through the Metaverse and exploring various ways of using it.

Despite this surge of interest in the Metaverse around the world, there is no guarantee that the Metaverse will lead to mass adoption through active consumer acceptance. As evidenced by the examples of 3D TV, smart TV, and video phone, it is apparent that new media technologies might encounter consumer resistance and experience a delay in achieving widespread adoption, contrary to earlier projections. Hence, in order to facilitate the widespread acceptance and adoption of the Metaverse while mitigating potential consumer resistance, it is imperative to conduct research aimed at forecasting and analyzing the determinants that impact consumer acceptability.

On the other hand, the results of the literature analysis on Metaverse research achievements show that there are not many Metaverse-related studies in general, and studies from the user perspective are very scarce. The trends of Metaverse-related research, including related technologies and services, can be summarized as follows.

First, research on the concept, status, and direction of development. As Metaverse research is currently in its infancy, most of the studies conducted so far have discussed the concept of Metaverse, definitions of types, technology and policy trends, future

development prospects, and activation measures(Lee et al., 2021; Go et al., 2021; Lee, 2021). Second, research on the technical dimension. In Korea, there have been many studies on the technical implementation and development of Metaverses, focusing on engineering (Duan et al., 2021; Park & Kim, 2022). Third, research on Metaverses from the user's perspective. To date, studies on the user side of the Metaverse have mostly focused on services using augmented reality and virtual reality technologies, which are sub-constructs of the Metaverse, and their acceptance intentions (Badamasi et al., 2021; Xi & Hamari, 2021; Zhang et al., 2020; Lee et al., 2021; Jeon & Nam, 2020; Hong & Han, 2020).

Despite the industry and user interest and expectations for the Metaverse, there are relatively few studies on Metaverse acceptance and usage intentions that have conducted value assessment and understanding from the user's perspective, taking into account the characteristics of the Metaverse. In addition, for Metaverse services and content to be widely accepted and disseminated, it is necessary to evaluate, understand, and explore their value by considering various factors that affect users' intention to use them in the early stages of development. Therefore, it is necessary to conduct more research in this area in the future.

There are many factors that influence the intention to use Metaverse services and contents in the early stages of development. The Technology Acceptance Model (TAM), which has been the basis of most studies so far, is a model that focuses on technical characteristics. Therefore, the first objective of this study is to investigate how the characteristics of the metaverse influence the acceptance of the metaverse using VAM(Value-based Adoption

Model) rather than TAM. Second, instead of the existing piecemeal approach to technology acceptance, we tried to consider the technical aspects of Metaverse (telepresence, interoperability, seamlessness, concurrence, economy flow) and personal aspects (social influence and self-efficacy) along with the economic aspects (benefits and sacrifices) of accepting new technologies. Third, we also conducted a necessary condition analysis to determine whether Metaverse characteristics were necessary for perceived usefulness and perceived enjoyment.

2.2 Conceptual framework and Hypothesis

2.2.1 VAM(Value-based Adoption Model)

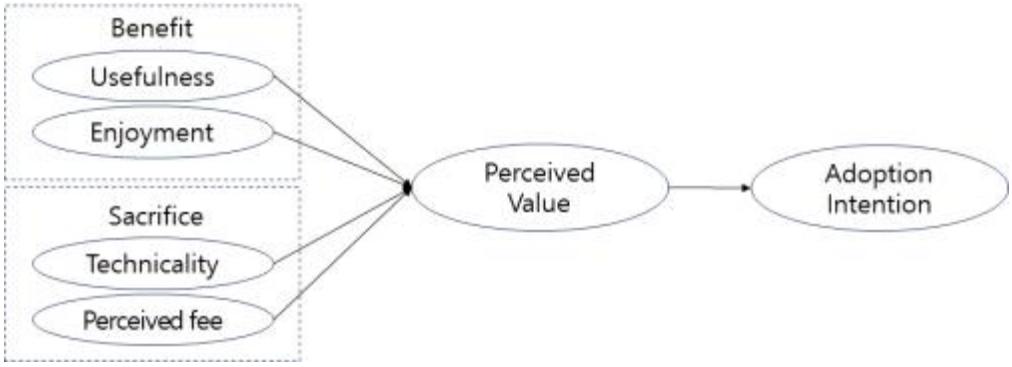
The Value-based Adoption Model (VAM) is a theory first proposed by Kim et al. (2007) and is an acceptance model that focuses on the value maximization of individual consumers in that the Technology Acceptance Model (TAM), a representative acceptance model proposed by Davis (1989), has limitations in explaining the acceptance factors of new ICT technologies, and ICT users should be perceived as 'consumers' rather than technology users (Kim et al., 2007).

The value-based adoption model recognizes individuals as technology users and focuses on maximizing consumer value. It classifies benefits (usefulness, enjoyment) and sacrifices (technicality, perceived fee) as the main variables of perceived value and analyses the intention to use. Perceived value is an exchange transaction of benefits and sacrifices arising from the choice of new products and services and analyses the perceptual factors that are reflected in

users' decisions. In other words, the value-based adoption model is a model that analyses consumers' intention to adopt technology based on perceived value to overcome the limitations of the technology acceptance model in the new technology environment. 〈Figure 2-1〉 shows the value-based adoption model (Kim et al., 2007), and consumers' perception of value is a determinant of adoption intention, and each of the beliefs of benefit, which consists of usefulness and enjoyment, and sacrifice, which consists of technicality and perceived fee, are mediated through perceived value (Kim et al., 2007).

The value-based adoption model, which recognizes technology users as consumers and tests their acceptance intention based on their perceived value, is a useful model for studying consumer acceptance of emerging ICT-related products and services.

〈Figure 2-1〉 Value-Based Adoption Model(VAM)



Perceived benefits consist of extrinsic, cognitive usefulness and intrinsic, emotional enjoyment (Kim et al., 2007). Perceived usefulness is defined as the total value of a user's perceived performance when using a new technology, and is similar to product quality in marketing, which is defined as a customer's cognitive assessment of a product's excellence/superiority. Perceived enjoyment

is the degree to which the usage behavior itself is perceived as enjoyable, excluding the expected performance outcome of the product usage behavior. Individuals who experience immediate pleasure and enjoyment from a product use behavior, and who perceive it as having enjoyment value beyond its instrumental value, are more likely to use the product. This concept is consistent with emotional value, which Sweeney & Soutar (2001) define as the utility derived from the feeling or affective state produced by a product.

Perceived sacrifice includes both monetary sacrifice, which is usually measured based on the customer's perception of the actual price paid, including the actual price of the product, and non-monetary sacrifice, which is the unsatisfactory expenditure of time, effort, and money in purchasing and consuming the product; the monetary sacrifice component consists of the perceived fee and the non-monetary sacrifice component consists of technicalities (Kim et al., 2007).

Kim et al. (2007) proposed the VAM and applied it to a study of the intention to use mobile Internet and found that the intention to use mobile Internet is determined by the perceived value of mobile internet and that all five hypotheses were supported, namely that the perceived usefulness, enjoyment, fee, and technicality of mobile Internet have a significant effect on the perceived value. In addition, perceived sacrifices were found to have a greater impact on perceived value than perceived benefits, which is explained by the fact that even if customers perceive the benefits of mobile internet, they will not consider it worth using unless they perceive that the benefits outweigh the sacrifices (Kim et al., 2007).

H1. Perceived usefulness will positively influence perceived value.

H2. Perceived enjoyment will positively influence perceived value.

H3. Technicality will negatively influence perceived value.

H4. Perceived fee will negatively influence perceived value.

H5. Perceived value will positively influence intention to use.

2.2.2 Metaverse Attributes

In order to derive the characteristics of a Metaverse, it is first necessary to review the existing research on the factors that facilitate customer experience in a Metaverse. Prominent figures and researchers who have recently discussed Metaverse characteristics include Clink CEO Chad Richman (2020), Cuofano (2022), and Roblox CEO Baszucki (2020), and researchers who have recently discussed Metaverse characteristics include Go et.al. (2021) and Kim and Shin (2021).

CEO Chad Richman described the common characteristics of the metaverse as "collective virtual shared space," meaning an open virtual space shared by all; "convergence with physical reality," meaning the connection between the digital and virtual worlds; and "persistence," meaning that the metaverse itself exists forever, regardless of whether an individual user accesses it or not. Cuofano(2022) outlined the key characteristics of a technologically evolving metaverse as Persistence, Synchronicity, Accessibility, Economic function, Scope, Interoperability, and Contribution. Baszucky(2020) proposed eight elements : Identity, Friends,

Immersive, Anywhere, Low Friction, Variety of Content, Economy, Civility. Go et al. (2021) proposed five elements: canon, creator, currency, continuity and connectivity.

While many scholars may use different terminology, the fundamental attributes of a Metaverse exhibit minimal divergence across their perspectives. In their recent publication, Kim and Shin (2021) introduced a comprehensive description of the key attributes of a Metaverse, drawing upon the concept of the ASF framework. These attributes include Seamlessness, Presence (Telepresence), Interoperability, Concurrence, and Economy Flow. According to the synopsis provided by Kim and Shin (2021), the attributes of the Metaverse can be delineated as follows.

Telepresence is a situation where there is no physical contact, but the user has a sense of spatial reality. Virtual reality is a representative channel for enhancing the sense of telepresence (Kim & Shin, 2021). The term "Telepresence" can be described as the individual's subjective perception of being physically present in a particular environment (Davis et al., 2009). It also encompasses the idea of being connected not just to a digital representation of oneself but also to other digital spaces and elements inside the actual world (Tasa & Görgülü, 2010). This phenomenon arises due to the significance of platforms in establishing a comparable encounter, hence augmenting the feeling of being fully engaged in an environment that lacks physical interaction for the user (Kim et al., 2022). Immersion in virtual worlds is crucial to enhance the sense of telepresence, and devices such as VR/AR devices can help. In addition, it is not only the technical aspects of VR and AR that create a sense of

telepresence, but also a well-crafted story, or narrative, that creates a sense of reality (Koo et al., 2022).

The study conducted by Lee et al. (2021) examined the various aspects that influence individuals' desire to utilize virtual reality (VR)-based digital content subscription services. The researchers discovered that telepresence, as one of the key attributes of VR content, positively influenced individuals' perceptions of both usefulness and enjoyment. Furthermore, Shin (2021) found that the higher the telepresence of social VR content, the higher the perceived usefulness and perceived enjoyment. Han & Ahn (2019) verified that telepresence influenced enjoyment and usefulness in a distribution environment using VR technology, which in turn influenced future intentions to use VR.

H6: Telepresence will have a positive influence on perceived usefulness.

H7: Telepresence will have a positive influence on perceived enjoyment.

Interoperability means that the real world and the data in the Metaverse are connected so that the results of the user's experiences and actions in the Metaverse are connected to the real world, and the experience in the Metaverse ecosystem is made more convenient by using information from the real world (Kim & Shin, 2021). Furthermore, the concept of interoperability pertains to the integration of data and information between the real world and the Metaverse. This integration enables the linkage of user experiences and actions in the Metaverse to real-world outcomes, thereby enhancing the

richness and convenience of the Metaverse experience through the utilization of real-world information (Kim & Lee, 2023). The loss in immersion of an online platform is likely to occur when the information provided is disconnected from real-world experiences or when it is not effectively shared among users (Koo et al., 2022). An example is the smart lens that exists in search engines such as Google and Naver. They allow us to see information about a product, its rating, and even where it's sold, by simply pointing the camera at it. Another example is when you use social media, such as Facebook, you may have seen personalized ads based on the information you have viewed (Kim & Shin, 2021).

According to McMillan and Hwang (2002), there exists a positive correlation between the perceived level of interoperability inside a specific system and the extent to which it influences favorable sentiments towards the technology. In a study conducted by Park and Nam (2017), the researchers examined the impact of perceived interoperability on information acceptance within the context of a mobile health information service. The findings of the study indicated that a greater perception of interoperability had a positive influence on both perceived usefulness and perceived ease of use. Consequently, this positive influence resulted in an increased intention to use the mobile health information service. According to Cha (2019), enhancing interoperability is crucial in the context of interactive content as it serves as a strategic tool that fosters more user engagement and immersion in the content, and applied the technology acceptance model to examine the acceptance of theatre advertisements using NFC technology, and found that interoperability positively increased perceived usefulness and perceived ease of use.

In addition, Shin (2021) found that the higher the interoperability of social VR content, the higher the perceived usefulness and perceived enjoyment.

H8: Interoperability will have a positive influence on perceived usefulness.

H9: Interoperability will have a positive influence on perceived enjoyment.

Seamlessness is the uninterrupted connection of experiences created in the metaverse: you can play a game with your own avatar, go shopping and interact with your friends without logging back in (Kim & Shin, 2021). Additionally, the concept of seamlessness pertains to the continuity of functionality inside a digital environment, even in instances where the user is away from it (Gilbert, 2011). As an illustration, within the context of Fortnite, individuals have the ability to engage in a battle royale-style gaming experience on a singular platform, thereafter transitioning seamlessly to a party royale area to spectate a live performance, or alternatively, to a communal space for the purpose of engaging in social interactions (Kim & Lee, 2023). The significance is in the ability to perform many tasks on a single platform, while also establishing a connection between one's activities and their historical record. The linkage between memories and information is established through continuity, rather than the introduction of novel connections and diverse characters across many locations, mirroring the manner in which individuals navigate their real-life experiences (Koo et al., 2022).

H10: Seamlessness will have a positive influence on perceived usefulness.

H11: Seamlessness will have a positive influence on perceived enjoyment.

Concurrence is an environment in which multiple users can operate together in the same metaverse and have a variety of different experiences at the same time. A virtual reality game, which is accessed by an individual and played according to a pre-created scenario, differs from this feature of the metaverse (Kim & Shin, 2021). Furthermore, the concept of concurrence posits that a platform should possess the capability to accommodate several users simultaneously (Kim & Lee, 2023). It refers not only to the connection of avatars in virtual reality, but also to another level, from physical reality to various digital spaces and surroundings (Tasa & Görgülü, 2010), meaning that a large number of users in remote physical locations can interact simultaneously (Gilbert, 2011). In the context of the real world, individuals do not independently generate and augment knowledge, but rather engage in collective endeavors to disseminate a diverse range of information (Kim & Lee, 2023). According to Kim et al. (2022), in order for a platform to possess value, it is imperative that it initially acquires a substantial user base.

H12: Concurrence will have a positive influence on perceived usefulness.

H13: Concurrence will have a positive influence on perceived enjoyment.

Economy flow refers to economic activities that allow users to trade goods and services based on the monetary instruments and transaction methods provided within the platform (Kim & Shin, 2021). Additionally, economy flow is the concept of whether the products or services available on the platform can be traded. The categorization of items can be based on their consumption patterns, irrespective of their production locations. These patterns include the consumption of offline products through online channels, the consumption of online products through online channels, and the consumption of online products through offline channels (Guo & Chow, 2008). This particular range of transactions has the potential to extend the duration of user engagement with the platform. In the context of gaming, users often want various products to personalize their character or enhance their character's progression. However, relying solely on in-platform activities may not suffice to accomplish their objectives. Consequently, users may resort to utilizing actual currency as a means to facilitate their progress (Kim & Lee, 2023). It is crucial to possess the capability to engage in trading activities within the platform, as it enables users to acquire distinctive assets within the Metaverse or access convenient features. This, in turn, promotes the long-term utilization of the platform (Kim et al., 2022).

H14: Economy Flow will have a positive influence on perceived usefulness.

H15: Economy Flow will have a positive influence on perceived enjoyment.

2.2.3 Individual Attributes

Social influence is defined as the extent to which important people in the user's life feel that the user should use a new information technology (Venkatesh et al. 2003). According to the theory of influence, individuals are inclined to adopt the viewpoints of those they consider significant within their social circles (Kim & Lee, 2023). When individuals are faced with little information or uncertainty, they tend to engage in internalization, a cognitive process whereby they construct their own opinions with the assistance of others (Deutsch & Gerard, 1955).

A study by Lee (2005) found that social influence through this internalization process indirectly affects the intention to use through perceived usefulness. In addition, social influence was found to have a static impact on perceived usefulness and intention to utilize the Metaverse (Oh, 2021). However, most of the existing studies have investigated whether social influence affects usage intention (Venkatesh et. al, 2003; Choi et. al, 2017; Oh, 2021). Therefore, in this study, we hypothesized that social influence only affects intention to use.

H16: Social influence will have a positive influence on intention to use the Metaverse.

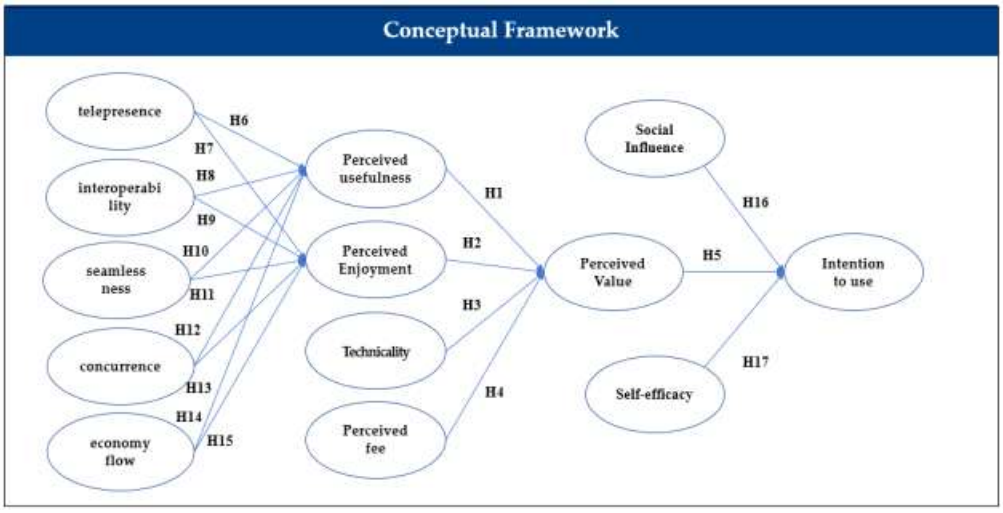
Self-efficacy refers to the degree to which a person believes he or she has the ability or skills to use a new innovative technology or product effectively (Ellen et al., 1991). Self-efficacy has been shown to influence an individual's decisions, efforts, and continuation of behavior (Compeau & Higgins, 1995). Previous studies have shown that higher self-efficacy has a positive effect on innovation acceptance (Ellen et al., 1991; Chen et al., 2009; Dabholkar &

Bagozzi, 2002; Hirschman, 1980). Previous studies have tested the hypothesis of the effect of self-efficacy on intention to use and found it to be statistically significant (Choi et. al, 2017; Oh, 2021). Therefore, in this study, self-efficacy, which is influential in the early stages of consumer acceptance and diffusion, is an important variable influencing intention to use Metaverse, and the following hypotheses are formulated.

H17: Self-efficacy will have a positive influence on intention to use the Metaverse.

The following conceptual framework is formed 〈Figure 2-2〉.

〈Figure 2-2〉 Conceptual Framework



2.3 Methods

2.3.1 Sample

Since the technical and personal characteristics of the metaverse platform are related to the adoption of the metaverse, the survey conducted for this study specifically focuses on individuals who possess prior experience with the metaverse platform. To achieve this, the researchers employed a quota sampling technique based on gender and age, as suggested by Kim and Lee (2023). The survey for the study was conducted with the assistance of an online research agency over a duration of two days in February 2023. The research agency's online panel was utilized to collect a total of 327 replies by quota sampling based on gender and age. The respondents were individuals who have utilized the Metaverse platform at least once, encompassing both males and females ranging from teenagers to individuals in their sixties residing in Korea. The demographic profile of the participants is presented in 〈Table 2-1〉. The sample's mean age was 31, with 76 individuals (23.2%) falling within the teenage and younger age group, 83 individuals (25.4%) falling within their 20s, 82 individuals (25.1%) falling within their 30s, and 86 individuals (26.3%) falling within their 40s and older. Additionally, there were 159 males (48.6%) and 168 females (51.4%) in the sample.

The purpose of using the Metaverse was more likely to be for enjoyment and fun (271, 82.9%) than for exploring and learning new information (56, 17.1%).

Among the participants, it was found that 115 individuals (equivalent to 35.2% of the total sample) utilize Minecraft as their primary Metaverse platform. This was followed by 75 respondents (22.9%) who reported using ZEPETO as their primary platform, 61 individuals (18.7%) who indicated Animal Crossing as their primary platform, 51 participants (15.6%) who reported Roblox as their

primary platform, 12 individuals (3.7%) who stated using Gather Town as their primary platform, another 12 respondents (3.7%) who reported Ifland as their primary platform, and finally, only one participant (0.3%) who mentioned Fortnite as their primary platform.

Furthermore, it is worth noting that 37 individuals, accounting for 11.3% of the total respondents, utilize the Metaverse platform on a near-daily basis. Additionally, 71 respondents (21.7%) reported using the platform every 2-3 days, while 69 respondents (21.1%) engage with it once a week. Moreover, 45 individuals (13.8%) utilize the platform every 2-3 weeks, and a majority of 105 respondents (32.1%) reported using it once a month or less frequently.

〈Table 2-1〉 Sample description (N = 327).

Construct		Frequency(N)	Percent(%)
Gender	Female	168	51.4
	Male	159	48.6
Age	~19	76	23.2
	20~29	83	25.4
	30~39	82	25.1
	40~	86	26.3
Purpose of using Metaverse	Utilitarian	56	17.1
	Hedonic	271	82.9
Preferred Metaverse Platforms	Minecraft	115	35.2
	ZEPETO	75	22.9
	Animal Crossing	61	18.7
	Roblox	51	15.6
	Gather Town	12	3.7
	Ifland	12	3.7
	Fortnite	1	0.3
Frequency of using Metaverse	Almost every day	37	11.3
	Once every 2-3 days	71	21.7
	Once a week	69	21.1
	Once every 2-3 weeks	45	13.8
	Once a month or less	105	32.1

2.3.2 Measurement

The study incorporates a set of variables, consisting of five independent variables that represent various features of the Metaverse (telepresence, interoperability, seamlessness, concurrence, and economy flow), as well as two independent factors that capture individual traits (Social Influence and Self-efficacy), five parameters (Perceived Usefulness, Perceived Enjoyment, Technicality, Perceived Fee, Perceived Value), and the dependent variable (Intention to use) are 13 in total, and are operationally defined as shown in 〈Table 2-2〉 based on past studies.

〈Table 2-2〉 Operational definition of variables

Construct	Operational Definition	Related studies
Tele-presence	Perceived psychological identification in the context of using metaverse services	Kim et. al.(2022), Davis et al.(2009), Dionisio et al.(2013), Gilbert(2011), Guthrie et. al.(2011), Noor(2010), Tasa and Görgülü(2010)
Inter-operability	The extent to which data and information on the Metaverse platform interoperates with the real world when accessed by users	Kim et. al.(2022), Cammack(2010), Davis et al.(2009), Dionisio et al.(2013), Noor(2010), Tasa and Görgülü(2010)
Seam-lessness	The degree to which the metaverse maintains its operational state in the absence of user connectivity to the digital environment	Kim et. al.(2022), Gilbert(2011), Tasa and Görgülü(2010), Guthrie et al.(2011), McKerlich et al.(2011), Noor(2010)
Con-currence	The degree to which the Metaverse platform allows for concurrent access by numerous users	Kim et. al.(2022), Cammack(2010), Gilbert(2011), Guthrie et al.(2011), McKerlich et al.(2011), Tasa and Görgülü(2010)

Economy flow	The degree to which users are able to engage in the exchange of goods or services inside the framework of the Metaverse platform	Kim et al.(2022), Cammack(2010)
Social Influence	The extent to which your use of the metaverse is influenced by the people around you	Son et al. (2014), Oh (2021), Park & Kang (2021)
Self-efficacy	Level of confidence in ability to excel at the behaviors required to use the Metaverse	Oh (2021), Park & Kang (2021), Eastin & LaRose, 2000)
Perceived Enjoyment	The degree to which the utilization of the Metaverse is considered as pleasurable or entertaining	Kim et al.(2007), Oh (2021), Park & Kang (2021)
Perceived Usefulness	The extent to which Metaverse use is perceived to be useful in improving quality of life compared to before	Qiao & Han (2019), Oh (2021), Park& Kang (2021)
Perceived fee	Perceived cost of using the Metaverse, perceived irrationality of cost, and perceived dissatisfaction with cost.	Kim et al.(2007), Shin(2021)
Tech-nicality	The degree to which you are aware of the technical elements that you need to learn to use the Metaverse, such as how to use it, how to operate it, and how proficiently to use it.	Kim et al.(2007), Shin(2021), Son et al.(2014)
Perceived Value	Perceived sacrifice of time, money, and effort to use the Metaverse versus the overall benefits of using it	Kim et al.(2007), Shin(2021)
Intention to use	The intention or plan to continue using the metaverse service in the future	Davis et al. (1989), Venkatesh et al. (2003)

2.3.3 Data Analysis

2.3.3.1 PLS Path Modeling

This study employed partial least squares (PLS) path modelling to estimate the relationships hypothesized in this model. There are two approaches for specifying and testing hypothesized relationships in path analysis (Hair et al., 2010): covariance-based structural equation modeling (CB-SEM) and PLS-SEM).

The CB-SEM approach utilizes a maximum likelihood estimation (MLE) technique to estimate model coefficients with the objective of minimizing the gap between the estimated and sample covariance matrices (Hair et al., 2014). CB-SEM is suitable for studies that focus on model fit and testing the adequacy of the theoretical framework. On the other hand, Partial Least Squares Structural Equation Modeling (PLS-SEM) is a statistical technique that aims to estimate model parameters by maximizing the variation explained in endogenous variables. This approach is particularly favored in research endeavors that focus on theory creation and prediction (Hair et al., 2014).

PLS path modeling is also recommended over CB-SEM for testing complex models with numerous latent variables (Henseler et al., 2009). In contrast to the mean of 4.4 latent variables seen in a CB-SEM study conducted by Shah and Goldstein (2006), our work presents a model that encompasses 13 latent variables. Furthermore, the objective of this research is to investigate the influence of Metaverse characteristics on the intention to use, with a focus on establishing a novel theoretical framework rather than merely

affirming or verifying existing ideas. Based on the aforementioned justifications, it is deemed that employing a PLS path modeling approach is better suitable for conducting data analysis in the present study. According to Hair et al. (2017), a rough estimate of the sample size can be calculated as 10 times the number of variables included in the analysis, which is known as the 10-fold rule. According to this rule, the number of constructs in this study is 13 and the number of structural path is 17, so only 170 samples are needed, but 327 samples are sufficient for this study. Despite the fact that PLS-SEM has demonstrated its efficacy in analyzing small sample sizes, prior research has indicated the feasibility of employing PLS-SEM with a comparatively larger sample size of 851 participants (Anderson et al., 2011). The two-stage process, as presented by Anderson and Gerbing (1988), involved the initial validation of the measurement model, followed by the utilization of the bootstrapping technique in order to test hypotheses.

2.3.3.2 Necessary Condition Analysis(NCA)

NCA is a relatively new data analysis technique that helps identify necessary conditions within a data set (Dul, 2016; Dul & Goertz, 2018). It complements traditional analysis techniques like multiple regression and structural equation modeling (Dul, 2016; Dul & Goertz, 2018; Richter et al., 2020). NCA differs from those techniques by focusing on identifying regions in scatterplots that indicate the presence of required conditions, rather than analyzing average relationships between variables. Instead of determining a linear relationship between dependent and independent variables, as done in ordinary least squares regression, NCA aims to identify a

ceiling line on top of the data. This ceiling line is represented as a non-increasing stepwise linear line (step function) or a simple linear regression line.

NCA offers two main benefits to researchers. First, it generates ceiling lines and bottleneck tables that visualize and interpret the relationship between predictors and outcome variables. This helps researchers understand the minimum values or conditions required for desired outcomes. Second, NCA calculates parameters such as the accuracy of the ceiling line and the effect size of the required conditions. It also performs significance tests to ensure accurate calculations and avoid errors (Dul, 2016; Dul et al., 2020). In NCA, a Cartesian coordinate system is used to plot predictor variables on the x-axis and the resulting values of observed cases on the y-axis. A ceiling line is then drawn between the region containing the observation and the region not containing the observation. While various techniques can be used to determine the ceiling line (Dul, 2016), 〈Figure 2-3〉 illustrates two basic ceiling lines: (1) the Ceiling Envelopment - Free Disposal Hull (CE-FDH) line, which is a non-increasing stepwise linear line (step function), and (2) the Ceiling Regression - Free Disposal Hull (CR-FDH) line, which is a simple linear regression line through the CE-FDH line.

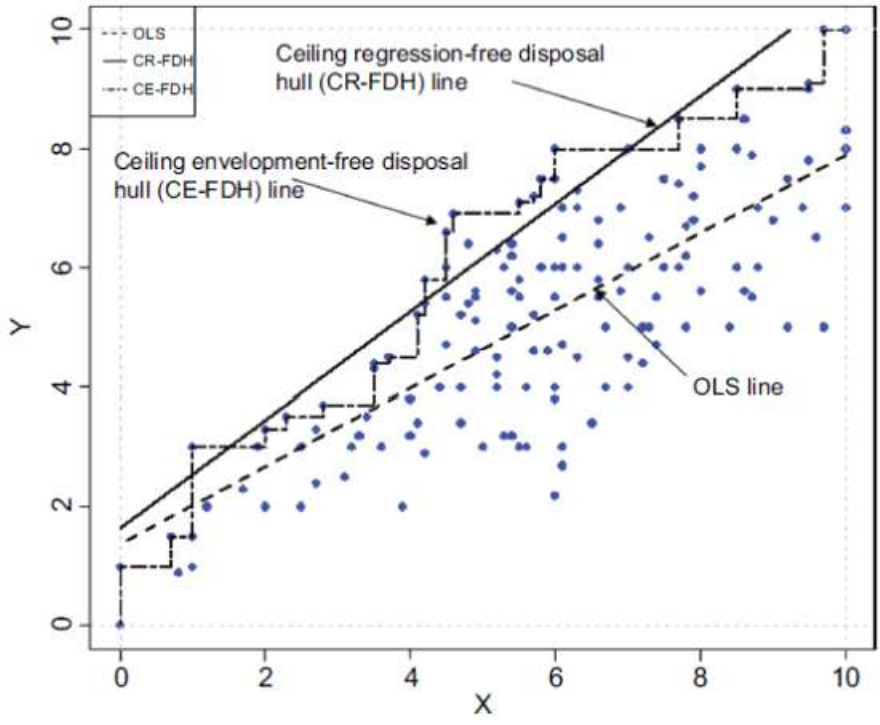
The ceiling line separates the space with observations from the space without observations. The larger the empty space, the greater the constraint that X imposes on Y. The ceiling line also represents the minimum level of X required to obtain a given level of Y.

Thus, the bottleneck analysis is used to further specify which predictor levels are required for different levels of the outcome. To

determine the size of the hypothesized requirement, NCA uses an effect size measure. This effect size measure (d) is expressed as the ratio between the area containing the observation (S) and the area not containing the observation (C), and can be expressed as follows d = C/S. Dul (2016) also introduces a general threshold between different effect sizes d, where 0 < d < 0.1 corresponds to a "small" effect size, 0.1 ≤ d ≤ 0.3 to a "medium", 0.3 ≤ d ≤ 0.5 to a "large", and 0.5 ≤ d ≤ 1 to a "very large" effect size (Dul, 2016).

Following this suggestion, previous studies have used a threshold of d = 0.1 to accept the necessity hypothesis (Karwowski et al., 2016; Van Der Valk et al., 2016). However, the absolute value of d only indicates practical significance, i.e., the significance of the effect size from a practical perspective. Therefore, NCA allows researchers to assess the statistical significance of the necessity effect size calculated by the permutation test, which is also taken into account when establishing the necessity hypothesis (Dul et al., 2020). Therefore, in order to claim that a condition is a necessary condition, it must meet three main criteria: i) it must have a theoretical justification, ii) the effect size d must be greater than 0, and iii) the condition must have a small p-value in a significance test (e.g., p < .05) (Dul et al., 2020).

〈Figure 2-3〉 Scatter plot with OLS and ceiling lines



2.4 Results

2.4.1 Measurement Validation

The measurement model was evaluated by examining convergent validity and discriminant validity. Convergent validity pertains to the examination of the relationship between various measurements and a shared conceptual construct (Dinev & Hart, 2004). 〈Table 2-3〉 shows that all thirteen constructs met the required thresholds as Composite Reliability was above 0.7 and Average Variance Extracted exceeded 0.5 (Hair et al., 2014). According to Fornell and Larcker (1981), Cronbach's Alpha, a measure used to assess internal consistency, exceeded the threshold of 0.7. Thus, the convergent validity of the constructs was established.

The Fornell-Larcker and Heterotrait-Monotrait criteria were examined to test the discriminant validity. Discriminant validity refers to the degree to which a measurement effectively distinguishes itself from other constructs within the nomological network (Dinev & Hart, 2004). 〈Table 2-4〉 depicts the Fornell-Larcker criterion in which the square roots of Average Variance Extracted from the constructs were Concurrence (0.804), Economy flow (0.867), Perceived Enjoyment (0.846), Perceived Fee (0.780), Intention to Use (0.884), Interoperability (0.823), Seamlessness (0.761), Self-efficacy (0.850), Social Influence (0.805), Technicality (0.892), Telepresence (0.849), Perceived Usefulness (0.798), and Perceived Value (0.895), which were higher than the correlation values between each construct as well as all other constructs. Therefore, discriminant validity was established according to the Fornell-Larcker criterion. 〈Table 2-5〉 shows the Heterotrait-Monotrait ratio of the constructs, and since all the constructs had HTMT less than 0.9 (Henseler et al., 2015), the measurement model's discriminant validity was established.

Next, the R^2 (Adjusted R^2) value was evaluated. Metaverse attributes accounted for 47.5%(46.7%) of the explained variance for Perceived Usefulness and 38.1%(37.2%) of the explained variance for Perceived Enjoyment. Also, Perceived Usefulness, Perceived Enjoyment, Technicality and Perceived Fee accounted for 37.0%(36.2%) of the explained variance for Perceived Value. In addition, Perceived Value, Social Influence and Self-efficacy represented 48.0%(47.5%) of the explained variance for Intention to Use.

〈Table 2-3〉 Cronbach's Alpha, composite reliability, and average variance extracted of constructs.

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Telepresence	0.806	0.885	0.721
Interoperability	0.842	0.894	0.678
Seamlessness	0.785	0.845	0.580
Concurrence	0.726	0.845	0.646
Economy flow	0.839	0.901	0.752
Perceived Usefulness	0.810	0.875	0.637
Perceived Enjoyment	0.867	0.910	0.716
Technicality	0.914	0.939	0.795
Perceived Fee	0.760	0.819	0.608
Perceived Value	0.875	0.923	0.801
Social Influence	0.730	0.847	0.648
Self-efficacy	0.809	0.887	0.723
Intention to Use	0.861	0.915	0.782

〈Table 2-4〉 Discriminant validity - Fornell-Larcker criterion.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	**0.804**												
2	0.504	**0.867**											
3	0.503	0.345	**0.846**										
4	0.092	0.288	0.109	**0.780**									
5	0.481	0.380	0.687	0.124	**0.884**								
6	0.643	0.473	0.518	0.069	0.547	**0.823**							
7	0.299	0.130	0.099	0.154	0.121	0.143	**0.761**						
8	0.367	0.284	0.337	0.113	0.356	0.406	0.134	**0.850**					
9	0.373	0.393	0.349	0.393	0.515	0.426	0.185	0.292	**0.805**				
10	−0.010	0.203	−0.037	0.567	−0.018	0.007	0.137	−0.027	0.302	**0.892**			
11	0.435	0.355	0.494	0.257	0.533	0.496	0.266	0.282	0.481	0.170	**0.849**		
12	0.519	0.444	0.663	0.224	0.678	0.622	0.127	0.405	0.543	0.144	0.524	**0.798**	
13	0.399	0.411	0.539	0.194	0.648	0.495	0.102	0.303	0.525	0.183	0.412	0.535	**0.895**

* 1: concurrence, 2: economy flow, 3: enjoyment, 4: perceived fee, 5: intention to use, 6: interoperability, 7: seamlessness, 8: self-efficacy, 9: social influence, 10: technicality, 11: telepresence, 12: usefulness, 13: perceived value

〈Table 2-5〉 Discriminant validity - Heterotrait-Monotrait criterion.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1													
2	0.639												
3	0.634	0.394											
4	0.140	0.311	0.135										
5	0.609	0.431	0.796	0.106									
6	0.822	0.548	0.604	0.081	0.641								
7	0.390	0.163	0.110	0.224	0.130	0.188							
8	0.472	0.342	0.397	0.138	0.422	0.491	0.196						
9	0.508	0.490	0.431	0.480	0.641	0.537	0.256	0.381					
10	0.081	0.237	0.121	0.628	0.074	0.063	0.164	0.063	0.382				
11	0.569	0.431	0.588	0.283	0.639	0.602	0.340	0.348	0.632	0.202			
12	0.673	0.517	0.798	0.256	0.810	0.750	0.144	0.502	0.695	0.162	0.650		
13	0.500	0.472	0.616	0.171	0.744	0.577	0.122	0.361	0.655	0.202	0.490	0.631	

* 1: concurrence, 2: economy flow, 3: enjoyment, 4: perceived fee, 5: intention to use, 6: interoperability, 7: seamlessness, 8: self-efficacy, 9: social influence, 10: technicality, 11: telepresence, 12: usefulness, 13: perceived value

2.4.2 PLS Path Modeling and Hypotheses Testing

Prior to conducting the evaluation of the structural model, it is necessary to assess the presence of multicollinearity in order to ascertain the validity of the obtained results. According to Hair and Lukas (2014), the Variance Inflation Factor (VIF) values observed in

the model were all below 5, ranging from 1.351 to 3.601. This suggests that there is no evidence of multicollinearity present in the model. Subsequently, the structural model underwent evaluation by the bootstrapping technique, employing 5,000 resamples, in order to ascertain the statistical significance of the hypotheses (refer to 〈Table 2-6〉).

〈Table 2-6〉 Results of hypothesis testing.

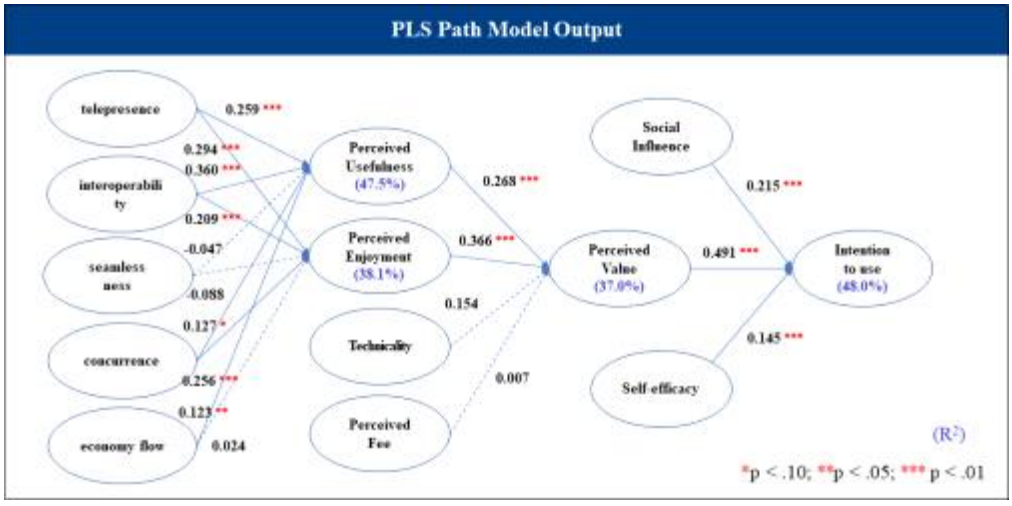
Hypo	Path	β	s.e.	t-value	p-value	Result
H1	usefulness → value	0.268	0.078	3.459	0.001	Supported
H2	enjoyment → value	0.366	0.071	5.186	0.000	Supported
H3	technicality → value	0.154	0.061	2.530	0.011	Not Supported
H4	fee → value	0.007	0.071	0.097	0.923	Not Supported
H5	value → intention	0.491	0.054	9.140	0.000	Supported
H6	telepresence → usefulness	0.259	0.050	5.213	0.000	Supported
H7	telepresence → enjoyment	0.294	0.056	5.235	0.000	Supported
H8	interoperability → usefulness	0.360	0.052	6.944	0.000	Supported
H9	interoperability → enjoyment	0.209	0.077	2.703	0.007	Supported
H10	seamless → usefulness	-0.047	0.070	0.671	0.502	Not Supported
H11	seamless → enjoyment	-0.088	0.063	1.403	0.161	Not Supported
H12	concurrence → usefulness	0.127	0.073	1.743	0.081	Supported
H13	concurrence → enjoyment	0.256	0.075	3.390	0.001	Supported
H14	economy flow → usefulness	0.123	0.054	2.278	0.023	Supported
H15	economy flow → enjoyment	0.024	0.064	0.377	0.706	Not Supported
H16	social influence → intention	0.215	0.053	4.020	0.000	Supported
H17	self-efficacy → intention	0.145	0.045	3.243	0.001	Supported

Almost all hypotheses related to VAM were supported. Hypothesis 1~2 were supported, revealing that Perceived Usefulness (β =0.268, t=3.459, p=0.001) and Perceived Enjoyment (β =0.366, t=5.186, p=0.000) were positively associated with Perceived Value. Hypothesis 5 was supported, indicating that Perceived Value (β =0.491, t=9.140, p=0.000) was positively related to Intention to Use. However, Hypothesis 3~4 were not supported, indicating that Technicality (β =0.154, t=2.530, p=0.011) and Perceived Fee (β =0.007, t=0.097, p=0.923) were not negatively related to Perceived Value.

Hypotheses about the effects of Metaverse characteristics on Perceived Usefulness and Perceived Enjoyment were partially supported and partially rejected. The results show that Telepresence was positively associated with Perceived Usefulness (β =0.259, t=5.213, p=0.000) and Perceived Enjoyment (β =0.294, t=5.235, p=0.000). Interoperability had a significant effect on Perceived Usefulness (β =0.360, t=6.944, p=0.000) and Perceived Enjoyment (β =0.209, t=2.703, p=0.007). Concurrence was also positively associated with Perceived Usefulness (β =0.127, t=1.743, p=0.081) and Perceived Enjoyment (β =0.256, t=3.390, p=0.001). Meanwhile, Seamlessness was not positively related to Perceived Usefulness (β =−0.047, t=0.671, p=0.522) and Perceived Enjoyment (β =−0.088, t=1.403, p=0.161). On the other hand, Economy Flow had a significant effect on Perceived Usefulness (β =0.123, t=2.278, p=.023), but not on Perceived Enjoyment (β =.024, t=0.377, p=0.706). Therefore, H6, H7, H8, H9, H12, H13 and H14 were supported but H10, H11 and H15 were not supported.

Meanwhile, Hypothesis 16 and 17 were supported, indicating that Social Influence (β =0.215, t=4.020, p=0.000) and Self-efficacy (β =0.145, t=3.243, p=0.001) were positively related to Intention to Use.

〈Figure 2-4〉 Partial Least Squares (PLS) Output

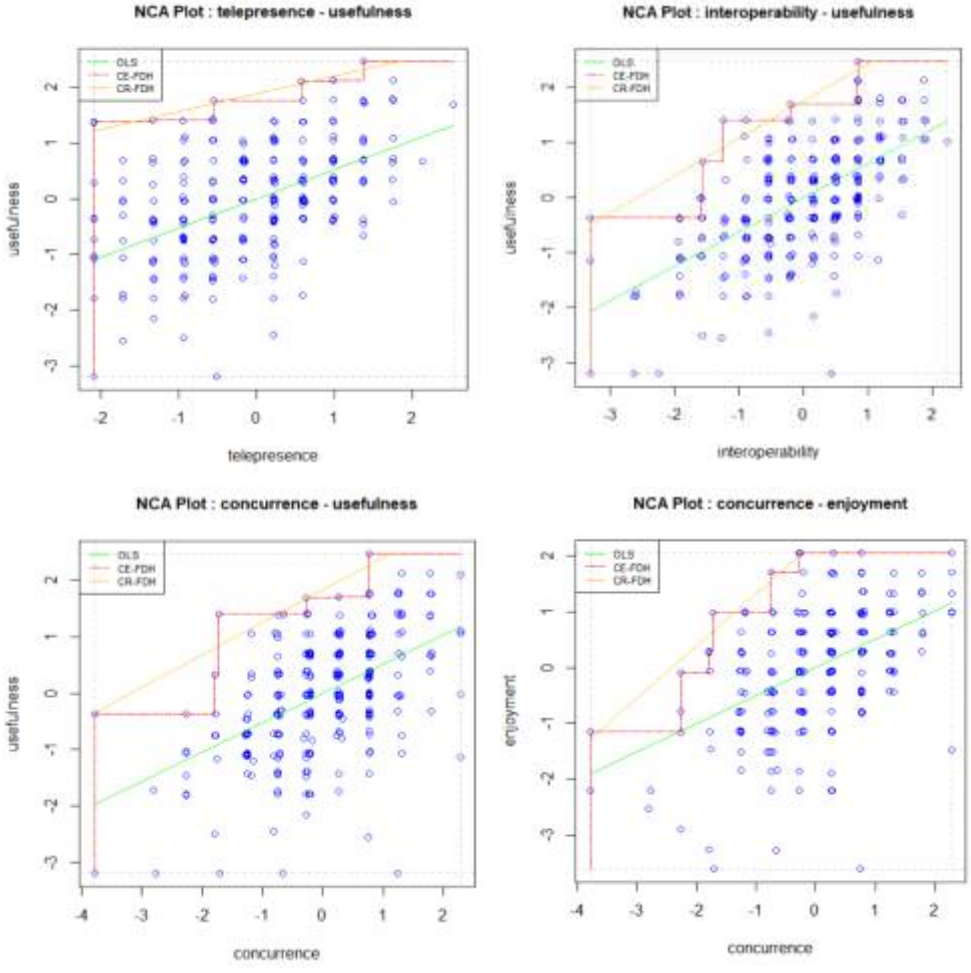


2.4.3 NCA

To further explore the relationship between Metaverse attributes and perceived usefulness and perceived enjoyment, we complemented PLS-SEM with Necessary Condition Analysis (NCA). Following the guidelines of Richter et al. (2020), we used the latent variable scores of the Metaverse attributes, perceived usefulness and perceived enjoyment, obtained using PLS-SEM, as a starting point when performing NCA. We imported these scores into the R software and followed the steps described in the quick start guide for running NCA (Dul, 2021). In order to keep our analysis from inferring additional linear assumptions, between the predictor and the outcome variables, we used the ceiling envelopment-free disposal hull (CE-FDH) line and the ceiling regression-free disposal hull (CR-FDH). This ceiling line also indicates

the minimum level of a particular Metaverse attribute that is required to achieve a given level of perceived usefulness and perceived enjoyment (see 〈 Figure 2-5〉).

〈Figure 2-5〉 NCA Plot



Furthermore, 〈Figure 2-5〉 also shows a ceiling regression - free disposal hull (CR-FDH), which can be used when there are many levels within the data, and when it can be considered continuous. The 〈Figure 2-5〉

also displays an OLS regression line running through the middle of the data as a reference point.

2.4.3.1 Effect size and significance testing

First, we examined the effect sizes (d) of the latent variable scores, testing their statistical significance using a recommended random sample size of 10,000 (Dul, 2016; 64 Dul et al., 2020; Dul, 2021). According to Dul and colleagues (Dul et al., 2020), in order for a condition to be considered necessary, it must meet three criteria: i) theoretical justification, ii) effect size d > 0, and iii) a small p value (p <.05). The NCA results (see <Table 2-7>) indicate that telepresence, interoperability and concurrence are necessary conditions for perceived usefulness. Specifically, telepresence, interoperability and concurrence are necessary for perceived usefulness, showing a small to medium effect size (d = 0.104, 0.237, 0.237) (Dul, 2016), which is statistically significant (p <.01) (Dul, 2021). Furthermore, the NCA results (see <Table 2-7>) indicate that concurrence is the only necessary condition for perceived enjoyment. Concurrence is necessary for perceived enjoyment, showing a small to medium effect size (d = 0.209) (Dul, 2016), which is statistically significant (p <.01) (Dul, 2021).

<Table 2-7> Ceiling Line Effect

Perceived usefulness	CE-FDH		CR-FDH	
	d	p	d	p
telepresence	0.104	0.002	0.093	0.001
interoperability	0.237	0.000	0.207	0.000
seamlessness	0.115	0.142	0.107	0.124
concurrence	0.237	0.001	0.200	0.003
economy flow	0.118	0.181	0.110	0.104

Perceived enjoyment	CE-FDH		CR-FDH	
	d	p	d	p
telepresence	0.030	0.191	0.015	0.286
interoperability	0.074	0.230	0.048	0.356
seamlessness	0.019	0.906	0.009	0.911
concurrence	0.209	0.000	0.173	0.000
economy flow	0.060	0.394	0.040	0.449

2.4.3.2 Bottleneck analysis

Next, in order to provide further details, we performed a bottleneck analysis (see 〈Table 2-8〉). For each desired outcome variable (perceived usefulness, perceived enjoyment) in the first column, 〈Table 2-8〉 shows the minimum values required for the predictor variables (telepresence, interoperability, seamlessness, concurrence and economy flow) in the following columns. According to 〈Table 2-8〉, in order to reach a medium-to-high level of usefulness (50%) , four necessary conditions need to be in place: interoperability at least 5.5%, seamlessness at least 0.6%, concurrence at least 3.4% and economy flow at least 0.9%. On the other hand, a high level of usefulness (100%) requires five necessary conditions to be met: telepresence at a minimum of 88.9%, interoperability at a minimum of 70.6%, seamlessness at a minimum of 85.9%, concurrence at a minimum of 67.6% and economy flow at a minimum of 47.4%.

In addition, in order to reach a medium-to-high level of enjoyment (50%), one necessary condition needs to be in place: concurrence at no less than 1.2%. Whereas, for a high level of enjoyment (100%), five necessary conditions need to be in place: telepresence at no less than 8.3%, interoperability at no less than 13.5%, seamlessness at no less than 11.9%, concurrence at no less than 31.2% and economy flow at no less than 3.1%.

〈Table 2-8〉 Bottleneck Table (percentage)

usefulness	tele-presence	inter-operability	seam-lessness	con-currence	economy flow
0.00%	NN	NN	NN	NN	NN
10.00%	NN	NN	NN	NN	NN
20.00%	NN	NN	NN	NN	NN
30.00%	NN	NN	NN	NN	NN
40.00%	NN	NN	NN	NN	NN
50.00%	NN	5.505	0.612	3.364	0.917
60.00%	NN	7.034	0.612	3.364	0.917
70.00%	NN	10.092	0.612	5.199	2.752
80.00%	NN	10.092	0.612	5.199	3.058
90.00%	63.609	70.031	26.300	67.584	3.058
100.00%	88.991	70.642	85.933	67.584	47.401
enjoyment	tele-presence	inter-operability	seam-lessness	con-currence	economy flow
0.00%	NN	NN	NN	NN	NN
10.00%	NN	NN	NN	NN	NN
20.00%	NN	NN	NN	NN	NN
30.00%	NN	NN	NN	NN	NN
40.00%	NN	NN	NN	NN	NN
50.00%	NN	NN	NN	1.223	NN
60.00%	NN	NN	NN	1.223	NN
70.00%	NN	NN	NN	5.199	0.917
80.00%	NN	2.752	NN	5.199	0.917
90.00%	8.257	2.752	NN	15.291	3.058
100.00%	8.257	13.456	11.927	31.193	3.058

2.5. Conclusion

2.5.1 Discussion

This study examines the factors that influence the intention to use Metaverse by applying the Extended Value-based Adoption Model (EVAM). The recent non-face-to-face daily life and rapid digital transformation caused by the COVID-19 pandemic have ushered in the era of Metaverse, a virtual world based on scalability beyond space and time constraints and a sense of reality similar to the real world (Lee, 2021). Nevertheless, the introduction of novel platforms like Metaverse does not automatically result in widespread dissemination due to user approval and adoption. The delay in popularization can be attributed to user rejection and resistance to innovation (Choi et al., 2017). Hence, in order to ensure the stable acceptance and proliferation of emerging platforms like Metaverse, it is imperative to thoroughly investigate and study the elements that influence users' intention to adopt and utilize Metaverse right from its earliest stage of acceptance and diffusion.

This empirical study examined the impact of various adoption factors on the intention to use the Metaverse using the Extended Value-based Adoption Model (EVAM). The factors influencing the intention to use the Metaverse were categorized as Metaverse characteristics, including Telepresence, Interoperability, Seamlessness, Concurrence, and Economy Flow, as well as personal characteristics, such as Social Influence and Self-efficacy. These factors were assessed using a structural equation model. We also conducted a necessary condition analysis to determine whether Metaverse characteristics were necessary for perceived usefulness and perceived enjoyment. The results are as follow.

First, Perceived Usefulness and Perceived Enjoyment were found to have a positive effect on Perceived Value. These results were consistent

with most existing studies(Kim et. al, 2007; Lee et. al, 2021, Shin, 2021). These results suggest that the more people perceive the Metaverse as useful and fun, the more valuable they find it to them. In addition, Perceived Value was found to have a positive effect on the intention to use the Metaverse. It was found that the value was formed and the intention to use it increased. On the other hand, Technicality and Perceived Fee did not have a statistically significant negative effect on Perceived Value. Many previous studies hypothesized that technicality would have a negative effect on perceived value and found a positive effect (Kim et. al, 2007; Lee et. al, 2021, Shin, 2021). The reason for these findings is that Metaverse is hedonic in nature, and because its users are mostly young or early adopters, they may feel that learning and using Metaverse is worth the effort, even if it is difficult. And, although not statistically significant, they feel that it is worth the cost of using Metaverse.

Second, among the Metaverse characteristics, Telepresence, Interoperability, Concurrence and Economy Flow were found to have a positive impact on Perceived Usefulness, and Telepresence, Interoperability and Concurrence were found to have a positive impact on Perceived Enjoyment.

Telepresence refers to the sensation of being present in a real environment, even when physically separated from it. The concept of telepresence is crucial for platforms aiming to create a similar and immersive experience that can compensate for the lack of physical contact in virtual environments. By enhancing the sense of immersion, telepresence plays a vital role in bridging the gap between the user and the digital world (Davis et al., 2009; Tasa & Görgülü, 2010; Kim et al., 2022). Our findings were consistent with previous studies in which

telepresence positively influenced perceived usefulness and perceived enjoyment(Lee et al., 2021; Shin, 2021; Han & Ahn, 2019). The higher this sense of telepresence, the more useful and fun the Metaverse platform was found to be. However, a certain level (see NCA bottleneck tables) of the exogenous construct is necessary for the outcome to manifest.

Interoperability pertains to the establishment of a connection between data and information in both the physical realm and the Metaverse. This connection enables the outcomes of user experiences and actions within the Metaverse to be linked to the real world. Consequently, the user's experience within the Metaverse is enhanced and made more convenient by leveraging lifelogging information obtained from the physical world. According to McMillan and Hwang (2002), there is a favorable correlation between a user's perception of interoperability inside a certain system and their views towards the technology. Our findings were consistent with previous studies in which interoperability positively increased perceived usefulness and perceived ease of use(Cha, 2019; Shin, 2021). The higher this interoperability, the more useful and fun the Metaverse platform was found to be.

Concurrence refers to the ability of a platform to accommodate multiple users simultaneously. In the real world, information creation and expansion often occur within large groups where people share diverse information. Therefore, for a platform to hold value, it is essential to have a substantial user base (Kim et al., 2022). It has been found that the degree of concurrence directly influences the perceived usefulness and enjoyment of using the Metaverse platform. The more concurrent the platform is, meaning the more users it can accommodate concurrently, the more valuable and engaging the user experience becomes within the

Metaverse. This is because increased concurrence fosters social interactions, information sharing, and a sense of community, which enhance the overall utility and enjoyment of the platform.

Economy flow refers to the presence of tradeable products or services within the platform. It involves the diversity of transactions that can take place, which in turn increases the user's immersion and engagement within the platform. The concept of economy flow suggests that the availability of various economic activities and exchanges enhances the overall user experience and utility of the Metaverse platform. The more economy flows there are, meaning the more opportunities for trade and transactions, the more valuable and useful the platform becomes. This is because a vibrant economy within the Metaverse stimulates user participation, interaction, and investment, thereby enriching the user's time spent within the platform.

Third, The NCA results indicate that telepresence, interoperability, and concurrence are necessary conditions for perceived usefulness, while concurrence is the only necessary condition for perceived enjoyment.

These minimum values indicate the threshold that each predictor variable needs to meet in order to achieve the desired level of usefulness or enjoyment. For example, to reach a medium-to-high level of usefulness, a Metaverse company must ensure that interoperability is at least 5.5%, seamlessness is at least 0.6%, concurrence is at least 3.4%, and economy flow is at least 0.9%. Similarly, to achieve a high level of usefulness, the company needs to meet the higher thresholds for each variable, such as having telepresence at a minimum of 88.9%, interoperability at a minimum of 70.6%, seamlessness at a minimum of

85.9%, concurrence at a minimum of 67.6%, and economy flow at a minimum of 47.4%.

For enjoyment, the analysis indicates that a medium-to-high level (50%) requires concurrence to be at least 1.2%. A high level of enjoyment (100%) necessitates meeting the higher thresholds for telepresence, interoperability, seamlessness, concurrence, and economy flow.

Finally, we found that Social Influence had a positive effect on Intention to Use the Metaverse. We found that the results are consistent with previous studies that social influence affects usage intention (Venkatesh et al., 2003; Choi et al., 2017; Oh, 2021). The findings indicate that individuals are more likely to see the Metaverse as useful and express a higher intention to utilize it when they observe a good perception of the Metaverse among their social circle. This suggests a significant social influence on individuals' beliefs and intentions about the utilization of the Metaverse. In addition, Self-efficacy had a static effect on the Intention to Use the Metaverse. These results are consistent with previous research showing that self-efficacy affects usage intention (Choi et al., 2017; Oh, 2021). This result suggested that the higher the self-efficacy, the higher the willingness to use the Metaverse, as shown in 〈Figure 2-4〉.

2.5.2 Theoretical and managerial implications

The theoretical implications of this study are as follows.

First, because Metaverse research is currently in its infancy, much of the research on Metaverse is conceptual and typological; however, this study provides a foundation for empirical Metaverse

research by examining its impact on Metaverse acceptance through actual Metaverse users.

Second, this study aims to investigate the determinants of intention to adopt Metaverse among current users, considering the current stage of Metaverse technology development. The factors influencing adoption intention are analyzed by categorizing them into two main dimensions: technology characteristics (telepresence, interoperability, seamlessness, concurrence, and economy flow) and personal characteristics (social influence and self-efficacy).

Third, while there have been studies on user acceptance of telepresence, interoperability, etc. in existing AR-VR studies, there have been no studies on Metaverse user acceptance of the five Metaverse characteristics used in this study.

Finally, this study demonstrates how PLS-SEM and NCA are complementary when the research goal is to explore Metaverse attributes that are important for high usefulness and enjoyment. This provides guidance for researchers who wish to apply these methods to develop further explanations of Metaverse acceptability. Therefore, one contribution could be to encourage and guide researchers to adopt a complementary approach by combining PLS-SEM and NCA appropriately when investigating the acceptance of Metaverses.

Based on the research findings that Telepresence, Interoperability, Concurrence, and Economy Flow have a positive impact on Perceived Usefulness in the Metaverse, and Telepresence, Interoperability, and Concurrence have a positive impact on Perceived Enjoyment, Metaverse companies can leverage these results to enhance its offerings and improve user satisfaction. Here's a more detailed explanation of how each characteristic can be utilized.

First, to improve telepresence, metaverse companies should develop immersive technologies such as virtual reality (VR) and augmented reality (AR) to create a sense of presence in the virtual environment. They should also implement realistic and interactive elements within the metaverse to enhance the feeling of being in the real world. To do this, they should look to the success of VR platforms such as Oculus Quest and HTC Vive in delivering immersive experiences and applying similar technologies to metaverse development.

Second, to promote interoperability, metaverse companies need to build seamless integration between the metaverse and the real world to enable data and information exchange. They also need to enable cross-platform compatibility so that users can access and interact with the metaverse from a variety of devices. To do this, they should study interoperable platforms such as Roblox, which allows users to create and share content on a variety of devices and operating systems.

Third, to promote concurrence, metaverse companies need to build a large user base to encourage social interaction, information sharing, and community building within the metaverse. They also need to provide features and incentives that promote collaboration and cooperation among users. To do this, they should look to the success of multiplayer games like Fortnite and Minecraft, where large communities engage in shared experiences, and apply similar mechanisms to promote concurrence in the metaverse.

Fourth, to facilitate economy flow, metaverse companies will need to integrate a virtual currency or token system to enable trading and transactions within the metaverse. They will also need to create marketplaces where users can buy, sell, and trade virtual assets and

services. To do this, they should investigate the success of blockchain-based platforms like Decentraland, which allows users to buy and sell virtual land and assets, and explore integrating similar economic systems.

By prioritizing and incorporating these characteristics into their Metaverse platform, a company can enhance the perceived usefulness and enjoyment of its users. This, in turn, can lead to increased user adoption, engagement, and loyalty, ultimately benefiting the company's success in the Metaverse. Additionally, the company can use these research findings as a basis for further innovation, continually refining and expanding their offerings to align with user preferences and needs in the evolving Metaverse landscape.

2.5.3 Limitations and future research

This section lists some limitations of this study that should be taken into account.

First, since the sample consisted of users who have used the Metaverse platform, it would be useful to study adoption resistance among non-users of the Metaverse platform in the future.

Second, it is worth noting that while the primary focus of this study was the desire to use Metaverse, it would have been more comprehensive to also inquire about the intention to continue using Metaverse, given that the survey targeted those who were already users of the platform.

Third, the present study was conducted utilizing the value-based adoption model. However, it is recommended that future research endeavors incorporate supplementary validation efforts by employing

alternative acceptance models, such as the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Expectation Confirmation Model.

Fourth, the metaverse has various technical characteristics such as telepresence, interoperability, seamlessness, concurrence, and economy flow, and personal characteristics such as social influence and self-efficacy, but this study covered five technical factors and two personal factors by synthesizing previous research on value-based adoption model and the characteristics of the metaverse. Therefore, the research model itself is somewhat complicated, and it would be good to analyze it again with a research model that excludes unnecessary variables through NCA(Necessary Condition Analysis) in the next study.

Chaper 3. Analyzing the Impact of Metaverse Characteristics on Intention to Use: Combining PLS-SEM and QCA within the combined model of TAM and ECM

3.1 Introduction

The COVID-19 pandemic has highlighted the need for industries to interact with each other in virtual space while remaining distant in real life, and the concept of metaverse has become a hot topic again. McKinsey & Company, one of the world's leading consulting firms, reported that more than $120 billion was invested in building metaverse technologies and infrastructure in the first five months of 2022, more than double the $57 billion invested in 2021 (McKinsey Blog, 2022). In addition, global market research firm Strategy analytics (SA) predicted that the global metaverse market size will grow from $16.2 billion in 2022 to $321 billion in 2027 (Macqueen, 2022). Gartner, a leading US information technology research firm, also predicted that by 2027, 30 per cent of people worldwide will spend two hours a day in a metaverse (Shin, 2022).

Despite the global increase of interest in the Metaverse, it cannot be guaranteed that mainstream adoption will be achieved just by active user approval. The examples of 3D TV, smart TV, and video phone provide as proof that new media technologies may face opposition from consumers and incur delays in attaining mainstream adoption, which contradicts earlier expectations. Therefore, it is crucial to do research that focuses on forecasting and analyzing the

factors that influence user acceptance in order to promote the universal acceptance and adoption of the Metaverse while addressing potential consumer resistance (Kim & Lee, 2023).

The most popular theoretical models used in research on the determinants of adoption and continued use of new information technologies or information systems are the Technology Acceptance Model and the Expectation Confirmation Model. Due to the advantages of simplicity and high explanatory power of the models, the Technology Acceptance Model and Expectation Confirmation Model, which have been used in many studies, have been developed in the direction of increasing the sophistication and explanatory power of the models by adding new variables, and on the other hand, applying them to various types of information systems to identify the determinants of purchase, repurchase, and continued use of information systems. The variables that have been found to be most influential in previous studies using these models, particularly the technology acceptance model, are perceived usefulness and perceived ease of use. The first technology acceptance model included only two independent variables, perceived usefulness and perceived ease of use, but subsequent studies have continuously added new variables, resulting in various forms of variation (King & He, 2006), and the expectation confirmation model has also been used to study the continuous use of various types of information systems since its introduction with only the variables of usefulness, expectation confirmation, satisfaction, and behavioral intention.

On the other hand, the existing literature analysis indicates that the number of studies on the metaverse, in general, is limited, and there is a scarcity of research from the user's perspective. However, the trends in metaverse-related research can be summarized as

follows. First, given the nascent stage of metaverse research, many studies have focused on understanding the concept of the metaverse, defining its types, and exploring technology and policy trends. These investigations aim to shed light on the future development prospects of the metaverse and propose measures for its activation (Lee et al., 2021; Go et al., 2021; Lee, 2021). Second, in Korea, a number of studies have focused on the technical implementation and development of metaverses, mainly from an engineering perspective. These studies explore the technical frameworks, architectures, and infrastructure required to build and support a metaverse environment. The goal is to address technical challenges and advance the functionality of the metaverse experience. (Duan et al., 2021; Park & Kim, 2022). Third, research from the user's perspective has primarily centered around services utilizing augmented reality (AR) and virtual reality (VR) technologies, which are sub-constructs of the metaverse. Studies in this area have examined user acceptance, intentions, and experiences related to AR/VR-based metaverse services. However, the overall number of studies focusing on the user side of the metaverse remains limited (Badamasi et al., 2021; Xi & Hamari, 2021; Zhang et al., 2020; Lee et al., 2021; Jeon & Nam, 2020; Hong & Han, 2020).

Despite the industry and user interest in the metaverse, there is a relative scarcity of studies that conduct value assessments and understand users' acceptance and usage intentions, taking into account the unique characteristics of the metaverse. To promote widespread acceptance and dissemination of metaverse services and content, it is essential to evaluate and explore their value, considering various factors that influence users' intention to use them, particularly in the early stages of development. Hence, it is imperative to conduct additional research in this domain in subsequent studies.

Numerous elements exert effect on the inclination to utilize Metaverse services and contents throughout the initial phases of their growth. The Technology Acceptance Model (TAM), which has served as the foundation for numerous research to date, is a theoretical framework that primarily emphasizes the technical attributes of technology. Therefore, the first objective of this study is to analyze the impact of metaverse characteristics on user acceptance by combining ECM (Expectation Confirmation Model) with the widely used TAM (Technology Acceptance Model). The second purpose of this study was to examine how metaverse characteristics affect user acceptance by separating technical factors (telepresence, interoperability, seamlessness, concurrence, economy flow). The third purpose was to conduct a QCA (Qualitative Comparative Analysis) to examine which combinations of Metaverse characteristics influence perceived usefulness and confirmation.

3.2 Literature Review and Hypothesis

3.2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), initially introduced by Davis (1989), is a theoretical framework that draws upon the theory of reasoned action in order to forecast an individual's inclination to embrace a novel technology. The Technology Acceptance Model (TAM) employs the idea of reasoned action as its theoretical foundation to delineate the causal connection between users' attitudes, intentions, and their actual behavior of accepting computers. This is achieved by considering the two primary factors that precede TAM, namely perceived usefulness and perceived ease of use. While the

theory of reasoned action (TRA) is more encompassing in its scope, the technology acceptance model (TAM) is specifically tailored to analyze computer usage behavior. However, TAM may be better suitable for modeling computer acceptance due to its incorporation of established insights from information systems research (Davis et al., 1989).

The Technology Acceptance Model (TAM) posits that an individual's inclination to embrace an information system is influenced by two cognitive constructs. Perceived usefulness refers to the degree to which an individual believes that utilizing a specific information technology can enhance their job performance. On the other hand, perceived ease of use pertains to the extent to which an individual anticipates being able to use a particular information technology effortlessly and without significant cognitive or physical exertion. The direct impact of perceived ease of use on perceived utility and technology utilization is evident.

While the initial theoretical framework of the Technology Acceptance Model (TAM) incorporated attitude as a factor, the subsequent model developed by Davis (1989) omitted attitude. This decision was based on empirical findings that indicated attitude served as a partial mediator between perceived usefulness and intention to use, with a weak direct relationship between perceived usefulness and attitude. However, a strong direct relationship was observed between perceived usefulness and intention to use. The elimination of attitude enables a more comprehensive comprehension of the impacts of perceived usefulness and perceived ease of use on the primary

dependent variable, intention (Venkatesh & Davis, 2000). Thus, the hypothesis provided for the Metaverse, utilizing the extended Technology Acceptance Model (TAM), might be stated as follows.

H1. Perceived ease of use will have a positive effect on perceived usefulness.

H2. Perceived usefulness will have a positive influence on intention to use the Metaverse.

H3. Perceived ease of use will have a positive influence on intention to use the Metaverse.

3.2.2 Expectation Confirmation Model (ECM)

Based on Davis' (1989) technology acceptance model and Oliver's (1980) expectation disconfirmation theory, the expectation confirmation model is a theory that perceived usefulness and satisfaction affect the intention to continue using. In other words, the degree of congruence or incongruence between the expectations that users have before using a new information technology and the actual use affects the satisfaction and perceived usefulness of the experience, which in turn determines the user's intention to continue using. While the technology acceptance model is a theory that explains the acceptance of new technologies and services and the variables that influence the adoption process, the expectation confirmation model is a theory that explains the variables that influence users' continued use of adopted technologies and services (Shin & Kim, 2012). Therefore, the expectation confirmation model can be said to be a theoretical foundation that can explain the influence on subsequent intention to use media, depending on whether the expectations held before use are fulfilled through use.

Bhattacherjee's (2001) model was very simple, but subsequent researchers have attempted to increase the explanatory power of the model by adding several variables that have been included in technology acceptance models – perceived ease of use, perceived enjoyment, and subjective norms. Hong, Thong & Tam (2006) added perceived ease of use to the existing expectation confirmation model and applied it to the study of continuous use of mobile Internet services. The results of the study reaffirmed the appropriateness of expectation confirmation model and showed that the added variable had the expected effect.

The expectation confirmation model posits that the degree of congruence or incongruence between users' pre-use expectations of a new information technology product and its actual use affects the degree of satisfaction with the experience and perceived usefulness, which ultimately affects the intention to continue using it (Bhattacherjee, 2001). In the original study by Bhattacherjee (2001), the expectation confirmation model was applied to the continuance use of online banking and the model's appropriateness was confirmed. They found that perceived usefulness was the most important antecedent of attitude in the technology acceptance model, while satisfaction had a greater impact on continuance intention in the expectation confirmation model. In Hong et al. (2006), expectation confirmation was found to influence perceived usefulness and satisfaction, and also had a significant effect on perceived ease of use.

H4. Confirmation will positively influence perceived usefulness.
H5. Confirmation will positively influence perceived ease of use.
H6. Confirmation will positively influence satisfaction.

H7. Perceived usefulness will positively influence satisfaction.

H8. Perceived ease of use will positively influence satisfaction.

H9. Satisfaction will have a positive effect on intention to use the Metaverse.

3.2.3 Metaverse Attributes

To uncover the defining features of a Metaverse, it is essential to examine the insights from various prominent figures and researchers who have explored this digital realm. Notable discussions on Metaverse characteristics have been contributed by Clink CEO Chad Richman (2020), Cuofano (2022), Roblox CEO Baszucki (2020), Go et.al. (2021), and Kim and Shin (2021).

〈Table 3-1〉 The defining features of a Metaverse

researchers	the defining features of a Metaverse
CEO Chad Richman (2020)	"Collective virtual shared space": Signifying an open virtual environment accessible and shared by all users. "Convergence with physical reality": Highlighting the seamless connection between the digital and virtual worlds. "Persistence": Referring to the continuous existence of the metaverse, regardless of individual user access.
Cuofano (2022)	Persistence : Continuing indefinitely without being terminated, paused, or reset Synchronicity: Ensuring real-time and synchronized interactions and events within the metaverse. Accessibility: Enabling broad access to virtual experiences across various devices and platforms. Economic function: Establishing an economic ecosystem with virtual currencies and transactions. Scope: Covering a diverse range of virtual content and experiences.

	Interoperability: Facilitating seamless interactions between different platforms and applications. Contribution: Encouraging user participation and contribution to the metaverse's development.
Roblox CEO Baszucki (2020)	Identity: Allowing users to create and personalize their digital identities and avatars. Friends: Facilitating social interactions and connections within the virtual realm. Immersive: Creating a deeply engaging and immersive experience for users. Anywhere: Allowing access to the metaverse from anywhere, regardless of location. Low Friction: Ensuring a smooth and frictionless user experience. Variety of Content: Offering diverse and engaging content, such as games and experiences. Economy: Establishing a virtual economy with transactions and digital assets. Civility: Fostering a positive and respectful online community within the metaverse.
Go et al. (2021)	Canon: Establishing shared narratives, stories, and experiences within the virtual world. Creator: Empowering users to be creators and actively contribute to the metaverse's content. Currency: Implementing virtual currencies and economic systems within the metaverse. Continuity: Ensuring the continuity and persistence of virtual experiences and environments. Connectivity: Facilitating seamless communication and interaction among users.

Although expressed differently by various researchers, the primary characteristics of a Metaverse do not significantly differ among them. Kim & Shin (2021) presented the SPICE model based

on ASF (Seamlessness, Presence(Telepresence), Interoperability, Concurrence, and Economy Flow) to further define the main characteristics of a Metaverse.

Telepresence refers to a state in which physical interaction is absent, yet the user experiences a perception of spatial reality. Virtual reality (VR) serves as a prominent medium for augmenting the perception of telepresence, as supported by the research conducted by Kim and Shin (2021). Telepresence can be defined as the subjective experience of being present in a physical environment (Davis et al., 2009) or the notion of being connected not only to a virtual representation but also to other digital spaces and surroundings in the physical world (Tasa & Görgülü, 2010). The rationale behind this practice stems from the significance of platforms striving to establish a comparable encounter, thereby augmenting the user's sense of immersion inside a world devoid of physical interaction (Kim et al., 2022). The enhancement of telepresence is contingent upon immersion in virtual environments, with virtual reality (VR) and augmented reality (AR) gadgets serving as valuable tools in achieving this objective. Furthermore, it should be noted that the establishment of telepresence in virtual reality (VR) and augmented reality (AR) experiences is not only reliant on technical elements. Rather, a meticulously constructed narrative or tale also plays a crucial role in engendering a perception of authenticity (Koo et al., 2022).

The study conducted by Lee et al. (2021) examined the various elements that influence individuals' intention to use virtual reality (VR)-based digital content subscription services. The findings of the study revealed that telepresence, one of the key properties of VR content, has a significant positive impact on both the perceived utility and perceived enjoyment of such services. In addition, Shin (2021)

discovered a positive correlation between the level of telepresence in social virtual reality (VR) material and the perceived utility of such content. The study conducted by Han and Ahn (2019) aimed to examine the impact of telepresence on the levels of enjoyment and usefulness inside a distribution environment facilitated by virtual reality (VR) technology. Furthermore, the researchers investigated how these factors subsequently influenced individuals' plans to use VR in the future. Kim et al. (2023) found that presence have a positive effect on expectation confirmation in a path analysis between the characteristics of metaverse platform services and expectation confirmation.

H10: Telepresence will have a positive impact on perceived usefulness.

H11: Telepresence will have a positive impact on confirmation.

Interoperability refers to the establishment of a connection between the physical world and the digital realm of the Metaverse, enabling the outcomes of users' interactions and activities within the Metaverse to have an impact on the physical world. This integration of the real world and the Metaverse ecosystem enhances user convenience by leveraging information derived from real-world sources (Kim & Shin, 2021). Moreover, interoperability refers to the process of establishing a connection between data and information in both the tangible world and the virtual reality space known as the Metaverse. This connection enables the outcomes of users' experiences and actions within the Metaverse to have an impact on the real world. Consequently, the utilization of information from the real world enhances the richness and convenience of the Metaverse

experience. The reduction in immersion of the platform is inevitable when online information is disconnected from the real world or when it is transmitted independently among users (Koo et al., 2022). One illustrative instance is the intelligent lens seen within search engines like Google and Naver. By utilizing the camera, these applications enable users to get pertinent details regarding a product, like its rating and retail availability. An other illustration pertains to the utilization of social media platforms, such as Facebook, where users may encounter targeted advertisements that are tailored to their preferences and interests, as informed by the content they have engaged with (Kim & Shin, 2021).

According to McMillan and Hwang (2002), the level of perceived interoperability inside a certain system has a direct impact on the extent to which it influences positive views towards the technology. The impact of perceived interoperability on information acceptance within the setting of a mobile health information service was investigated in a study done by Park and Nam (2017). The results of the study indicated that an increased impression of interoperability had a beneficial impact on individuals' perceived usefulness and perceived ease of use. Consequently, this resulted in a heightened intention to use the service. According to Cha (2019), enhancing interoperability is crucial in the context of interactive content as it serves as a valuable tool that enhances user engagement with the content. The study applied the technology acceptance model to investigate the acceptance of theater advertisements utilizing NFC technology. The findings revealed a positive relationship between interoperability and perceived usefulness, as well as perceived ease of use. Moreover, Shin (2021) discovered a positive correlation between the level of interoperability of social virtual reality (VR) material and

the perceived utility. Kim et al. (2023) found that interoperability have a positive effect on expectation confirmation in a path analysis between the characteristics of metaverse platform services and expectation confirmation.

H12: Interoperability will have a positive impact on perceived usefulness.

H13: Interoperability will have a positive impact on confirmation.

Seamlessness refers to the continuous integration of various experiences within the metaverse, wherein individuals can engage in activities such as gaming, shopping, and socializing without the need for repeated logins (Kim & Shin, 2021). Furthermore, the concept of seamlessness can be defined as the extent to which a digital environment maintains its operational functionality notwithstanding the user's disconnection from it (Gilbert, 2011). As an example, in the realm of Fortnite, users possess the capacity to partake in a gaming encounter characterized by a battle royale format on a unified platform. Subsequently, they can effortlessly shift to a designated party royale zone, where they can observe live performances, or alternatively, to a shared environment where they can engage in social interactions with other participants. What has significance in this context is the ability to engage in many activities inside a single platform, while also establishing a connection between one's past actions. According to Koo et al. (2022), the linkage between memories and information is established through continuity rather than the introduction of novel connections and diverse characters in various locations, mirroring the manner in which individuals connect and recall experiences in their everyday lives.

H14: Seamlessness will have a positive impact on perceived usefulness.

H15: Seamlessness will have a positive impact on confirmation.

Concurrence refers to a collaborative setting wherein numerous users can concurrently engage within a shared metaverse, hence facilitating diverse and simultaneous experiences. The distinction between a virtual reality game, which is accessible and performed by a person based on a pre-established scenario, and this particular characteristic of the metaverse has been noted by Kim and Shin (2021). Furthermore, concurrence refers to the concept that a platform should possess the capability to be accessed by several users simultaneously. The term "telepresence" encompasses not only the interconnection of avatars within virtual reality, but also extends to the bridging of real-life experiences with various digital spaces and surroundings (Tasa & Görgülü, 2010). This implies the potential for numerous users located in different physical locations to engage in simultaneous interactions (Gilbert, 2011). In reality, individuals do not operate in isolation when it comes to generating and disseminating knowledge, but rather engage in collective efforts within sizable communities to exchange many forms of information. As stated by Kim et al. (2022), the acquisition of a significant user base is crucial for a platform to possess value.

H16: Concurrence will have a positive impact on perceived usefulness.

H17: Concurrence will have a positive impact on confirmation.

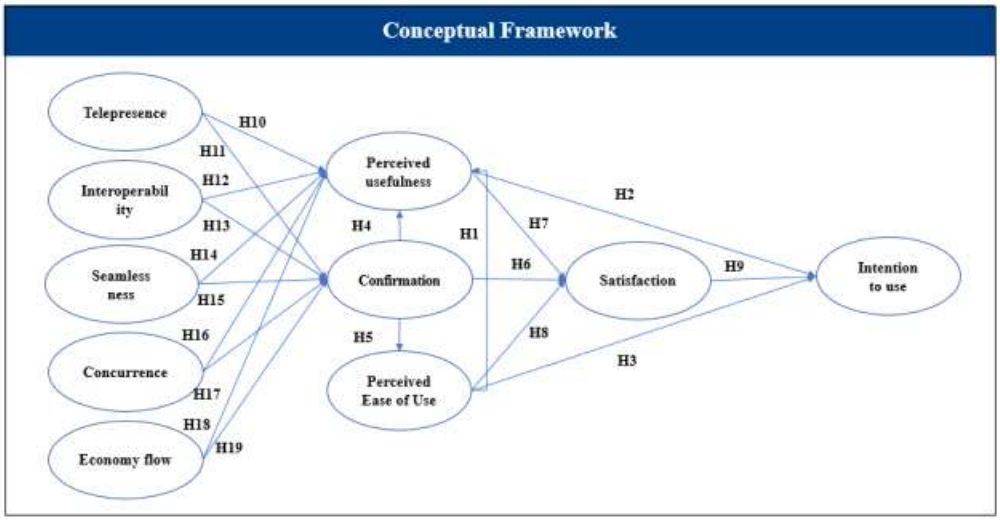
Economy flow refers to economic activities that allow users to trade goods and services utilizing monetary instruments and transaction techniques that are made available inside a given platform (Kim & Shin, 2021). Furthermore, the notion of economy flow pertains to the tradability of the products or services offered on the platform. The classification of objects can be determined by their patterns of consumption, regardless of where they were produced. The patterns encompassed in this study consist of three main categories: the consumption of offline items through online channels, the consumption of online products through online channels, and the consumption of online products through offline channels (Guo & Chow, 2008). This particular range of transactions has the potential to extend the duration of engagement with the platform. In the context of gaming, users often encounter the need for various things to personalize their character or enhance their character's progression. However, the attainment of these objectives solely through in-platform activities may prove insufficient, prompting users to resort to the utilization of actual currency as a means of assistance. The ability to participate in trading activities on the platform is of utmost importance, as it allows users to acquire unique assets inside the Metaverse or access convenient functionalities. According to Kim et al. (2022), this subsequently fosters the sustained utilization of the platform.

H18: Economy Flow will have a positive impact on perceived usefulness.

H19: Economy Flow will have a positive impact on confirmation.

The following conceptual framework is formed 〈Figure 3-1〉.

〈Figure 3-1〉 Conceptual Framework



3.3. Methods

3.3.1 Samples

The survey undertaken for this study primarily targets persons who possess a substantial level of knowledge with the Metaverse platform, as the technical qualities of the platform are closely associated with its acceptability. To achieve this, the quota sampling technique was employed, whereby participants were selected based on their gender and age.

The survey for this study was administered with the assistance of Embrain, an internet research organization, for a duration of two days on February, 2023. The online panel of the research firm was employed to gather a total of 327 responses through the method of

quota sampling, which involved selecting participants based on their gender and age.

The respondents were individuals who have used the Metaverse platform at least once, encompassing both males and females aged 14 to 64 years residing in Korea. The demographic characteristics of the participants are presented in Table 2. The demographic features of the sample utilized in this investigation are presented in 〈Table 3-2〉. The sample's mean age was 31, comprising 76 individuals (23.2%) in the age group of teenagers and under, 83 individuals (25.4%) in their 20s, 82 individuals (25.1%) in their 30s, and 86 individuals (26.3%) in their 40s and older. Additionally, there were 159 males (48.6%) and 168 females (51.4%) in the sample.

The predominant motivation for utilizing the Metaverse appeared to be centered around entertainment and leisure (271, 82.9%), rather than the pursuit of knowledge acquisition and exploration (56, 17.1%).Among the participants, it was found that Minecraft serves as the primary Metaverse platform for 115 individuals, accounting for 35.2% of the respondents. Following this, ZEPETO was reported as the principal platform by 75 individuals (22.9%), Animal Crossing by 61 individuals (18.7%), Roblox by 51 individuals (15.6%), Gather Town by 12 individuals (3.7%), Ifland by 12 individuals (3.7%), and Fortnite by only 1 individual (0.3%).

Additionally, it is noteworthy to mention that a total of 37 persons, including 11.3% of the overall respondents, engage with the Metaverse platform on a frequent basis, almost daily. Furthermore, 71 respondents (21.7%) reported using the platform every 2-3 days,

while 69 respondents (21.1%) indicated a weekly usage frequency. Moreover, 45 respondents (13.8%) reported using the platform every 2-3 weeks, and the remaining 105 respondents (32.1%) reported a monthly or less frequent usage of the platform.

〈Table 3-2〉 Sample description (N = 327)

Construct		Frequency(N)	Percent(%)
Gender	Female	168	51.4
	Male	159	48.6
Age	~19	76	23.2
	20~29	83	25.4
	30~39	82	25.1
	40~	86	26.3
Purpose of using Metaverse	Utilitarian	56	17.1
	Hedonic	271	82.9
Preferred Metaverse Platforms	Minecraft	115	35.2
	ZEPETO	75	22.9
	Animal Crossing	61	18.7
	Roblox	51	15.6
	Gather Town	12	3.7
	Ifland	12	3.7
	Fortnite	1	0.3
Frequency of using Metaverse	Almost every day	37	11.3
	Once every 2-3 days	71	21.7
	Once a week	69	21.1
	Once every 2-3 weeks	45	13.8
	Once a month or less	105	32.1

3.3.2 Measurement

The variables in the study are five independent variables representing Metaverse characteristics (telepresence, interoperability,

seamlessness, concurrence, and economy flow), four parameters (Perceived Usefulness, Perceived Ease of Use, Confirmation, Satisfaction), and the dependent variable (Intention to use) are 10 in total, and are operationally defined as shown in 〈Table 3-3〉 based on previous studies.

〈Table 3-3〉 Operational definition of variables

Construct	Operational Definition	Related studies
tele-presence	Perceived psychological identification in the context of using Metaverse services	Kim et. al.(2022), Davis et al.(2009), Dionisio et al.(2013), Gilbert(2011), Guthrie et. al.(2011), Noor(2010), Tasa and Görgülü(2010)
inter-operability	The extent to which data and information on the Metaverse platform interoperates with the real world when accessed by users	Kim et. al.(2022), Cammack(2010), Davis et al.(2009), Dionisio et al.(2013), Noor(2010), Tasa and Görgülü(2010)
seam-lessness	The extent to which the Metaverse continues to function even when users are not connected to the digital environment	Kim et. al.(2022), Gilbert(2011), Tasa and Görgülü(2010), Guthrie et al.(2011), McKerlich et al.(2011), Noor(2010)
con-currence	The extent to which multiple users can simultaneously access the Metaverse platform	Kim et. al.(2022), Cammack(2010), Gilbert(2011), Guthrie et al.(2011), McKerlich et al.(2011), Tasa and Görgülü(2010)
economy flow	The extent to which users can trade products or services that exist on the Metaverse platform.	Kim et al.(2022), Cammack(2010)
perceived usefulness	The extent to which Metaverse use is perceived to be useful in improving quality of life compared to before	Qiao & Han (2019), Oh (2021), Park& Kang (2021)

perceived ease of use	The degree to which a Metaverse is perceived as easy and convenient to use	Qiao & Han (2019), Oh (2021), Park& Kang (2021)
confirm-ation	The extent to which Metaverse users' pre-use expectations match and mismatch with their actual use.	Shin & Kim (2012); Bhattacherjee (2001); Tseng & Lo (2011)
satisfactio n	The level of satisfaction that Metaverse users have with the Metaverse.	Shin & Kim (2012); Bhattacherjee (2001); Tseng & Lo (2011)
intention to use	The intention or plan to continue using the Metaverse service in the future	Davis et al. (1989), Venkatesh et al. (2003)

3.3.3 Data Analysis

3.3.3.1 Overview

This study uses both SEM and QCA to explore the relationship between metaverse characteristics and perceived usefulness, expectation confirmation, satisfaction and intention to use. These two approaches have various goals and rely on various tenets. The SEM is a variable-centered method that depends on additive effects, linearity, and unity principles and concentrates on the net impact of independent factors on the dependent variable. Independent variables are viewed as competing to explain variance in the dependent variable (Woodside, 2013).

On the other hand, QCA is a case-centered method that emphasizes combinatorial effects. The approach presupposes equivalence, or the idea that there might be different solutions and paths leading to the same result. The method also allows for

combinatorial causality, where the constituent conditions may not be sufficient or necessary, but the causal composition of the conditions may be sufficient or necessary to achieve the outcome, and multifiniteness, where the same condition can cause or contribute to different outcomes (Rihoux & Ragin, 2009; Woodside, 2013).

3.3.3.2 PLS Path Modeling

To estimate the relationships predicted by this model, partial least squares (PLS) path modeling was utilized in this work. Covariance-based structural equation modeling (CB-SEM) and PLS-SEM are two methods used in path analysis (Hair et al., 2010) to specify or test predicted linkages. Maximum likelihood estimation (MLE) is a technique used in CB-SEM to estimate model coefficients "so that the discrepancy between the estimated and sample covariance matrices is minimized" (Hair et al., 2014). Studies that examine model fit and the suitability of the theoretical foundation should use CB-SEM. For research focused at theory creation and prediction, PLS-SEM is recommended because it estimates model parameters in a way that maximizes the variation explained in endogenous variables (Hair et al., 2014).

In addition, Henseler et al. (2009) suggest using PLS path modeling rather than CB-SEM for testing complex models with a large number of latent variables. The proposed model in our study comprises 10 latent variables, as opposed to the typical 4.4 latent variables in a CB-SEM (Shah & Goldstein, 2006). Also, rather than confirming or validating preexisting theories, this study's goal is to explore a potentially new theoretical framework by looking at the influence of Metaverse features on intention to use. For these reasons, the data analysis in this work is more suited to a PLS path

modeling approach. Hair et al. (2017) propose a method for estimating the sample size, referred to as the 10-fold rule, which involves multiplying the number of variables included in the study by a factor of 10. Based on the rule, the study encompasses a total of 10 constructs and 19 structural paths, suggesting a requirement of 190 samples. However, it is noteworthy that the study has been conducted with a sample size of 327, surpassing the minimum threshold. Although PLS-SEM has proven to be useful in assessing small sample sizes, previous studies have indicated the possibility of utilizing PLS-SEM with a moderately higher sample size of 851 people (Anderson et al., 2011). The research approach proposed by Anderson and Gerbing (1988) consisted of a two-stage methodology. In the first stage, the measurement model was validated, while in the second stage, the bootstrapping technique was employed to test the hypotheses.

3.3.3.3 Qualitative Comparative Analysis (QCA)

Qualitative comparative analysis is an analytical technique based on set theory that allows for in-depth analysis of how causal conditions contribute to an outcome. Qualitative comparative analysis assumes that the impact of certain attributes on a particular outcome depends not on the level of individual attributes, but on how the attributes combine. This method is attractive in current business and organizational settings, and many studies use this technique (e.g., Crilly, 2011; Calabuig et al., 2015; Skarmeas, Leonidou, & Saridakis, 2014).

The analysis uses fsQCA, which can combine all logically possible combinations of conditions to calculate calibration values and analyze the impact of metaverse characteristics on perceived usefulness and

expectation confirmation (Eng & Woodside, 2012). For fsQCA, this study converts raw data responses into fuzzy set responses. First, calculate the factor scores of the components. Then, the value of each variable is recalibrated by considering three thresholds (Woodside, 2013): 5% (low match or completely outside the set), 50% (moderate match, neither inside nor outside the set), and 95% (high match or completely in the set).

Finally, the Necessity and Sufficiency Tests assess the impact of various characteristic variables of the metaverse on perceived usefulness and expectation confirmation. The fsQCA generates three possible solutions: complex, parsimonious, and intermediate (the first solution is presented in this study).

3.4. Results

3.4.1 Measurement Validation

SEM was utilized to analyze the data using Smart-PLS 4.0 software. The measurement model is first evaluated using convergent and discriminant validity. The assessment of convergence validity is based on the average variance extracted (AVE) value, composite reliability (CR) value, and Cronbach's alpha (CA) value for internal consistency (Hair et al., 2017). According to the Fornell-Larcker criterion, discriminant validity is evaluated based on the square root of the AVE being more significant than the correlation between other variables in the model (Fornell & Larcker, 1981; Henseler et al., 2015). In addition, this study also evaluates the value of the variance inflation factor (VIF) to detect multicollinearity. According to

Diamantopoulos (2011), if the VIF value of less than 10 indicates there is no concern of multicollinearity.

〈Table 3-5〉 shows that all ten constructs met the required thresholds as Composite Reliability was above 0.7 and Average Variance Extracted exceeded 0.5 (Hair et al., 2014). The value of Cronbach's Alpha to determine internal consistency was also greater than 0.7 (Fornell & Larcker, 1981). Thus, the convergent validity of the constructs was established.

〈Table 3-6〉 depicts the Fornell-Larcker criterion in which the square roots of Average Variance Extracted from the constructs were Concurrence (0.804), Confirmation (0.874), Perceived Ease of Use (0.820), Economy flow (0.868), Intention to Use (0.884), Interoperability (0.823), Satisfaction (0.860), Seamlessness (0.773), Telepresence (0.849) and Perceived Usefulness (0.798), which were higher than the correlation values between each construct as well as all other constructs. Therefore, discriminant validity was established according to the Fornell-Larcker criterion. 〈Table 3-7〉 shows the cross-loading criterion in which all constructs' loadings were higher than cross-loadings with other constructs across the columns. Thus, discriminant validity was ascertained as per the cross-loading criterion.

Next, the R^2 (Adjusted R^2) value (Coefficient of determination) was evaluated. Metaverse attributes accounted for 53.5%(52.5%) of the explained variance for Perceived Usefulness and 35.2%(34.2%) of the explained variance for Confirmation. Also, Perceived Usefulness, Perceived Ease of Use and Confirmation accounted for 54.1%(53.7%) of the explained variance for

Satisfaction. In addition, Perceived Usefulness, Satisfaction and Perceived Ease of Use represented 72.3%(72.1%) of the explained variance for Intention to Use.

〈Table 3-4〉 Mean, SD, and loadings of constructs.

Construct	Item	Mean	SD	Loading
Telepresence	Tel1	2.939	0.981	0.822
	Tel2	2.896	1.062	0.892
	Tel3	2.612	1.016	0.830
Interoperability	Int1	3.287	0.862	0.815
	Int2	3.401	0.865	0.841
	Int3	3.492	0.867	0.836
	Int4	3.394	0.919	0.800
Seamlessness	Seam1	3.144	0.871	0.741
	Seam2	2.862	0.940	0.721
	Seam3	3.229	0.902	0.793
	Seam4	2.966	0.952	0.832
Concurrence	Con1	3.502	0.793	0.807
	Con2	3.318	0.855	0.796
	Con3	3.657	0.816	0.807
Economy flow	EF1	3.248	0.822	0.881
	EF2	3.217	0.845	0.849
	EF3	3.278	0.834	0.872
Perceived Usefulness	PU1	3.086	0.911	0.806
	PU2	3.242	0.867	0.783
	PU3	3.468	0.887	0.799
	PU4	3.266	0.867	0.805
Perceived Ease of Use	PEU1	3.547	0.784	0.835
	PEU2	3.450	0.837	0.841
	PEU3	3.367	0.919	0.805
	PEU4	3.404	0.930	0.797
Confirmation	CF1	3.422	0.774	0.855
	CF2	3.324	0.812	0.883
	CF3	3.309	0.824	0.883
Satisfaction	Sat1	3.459	0.724	0.849
	Sat2	3.410	0.822	0.870
	Sat3	3.291	0.866	0.862
Intention to Use	IU1	3.538	0.823	0.891
	IU2	3.336	0.862	0.903
	IU3	3.177	0.895	0.858

〈Table 3-5〉 Cronbach's Alpha, composite reliability, and average variance extracted of constructs.

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Telepresence	0.806	0.885	0.721
Interoperability	0.842	0.894	0.678
Seamlessness	0.785	0.856	0.598
Concurrence	0.726	0.845	0.646
Economy flow	0.839	0.901	0.753
Perceived usefulness	0.810	0.875	0.637
Perceived ease of use	0.838	0.891	0.672
Confirmation	0.845	0.906	0.764
Satisfaction	0.825	0.895	0.740
Intention to Use	0.861	0.915	0.782

〈Table 3-6〉 Discriminant validity - Fornell-Larcker criterion.

	1	2	3	4	5	6	7	8	9	10
Concurrence	**0.804**									
Confirmation	0.508	**0.874**								
Perceived ease of use	0.456	0.499	**0.820**							
Economy flow	0.504	0.355	0.222	**0.868**						
Intention to Use	0.481	0.612	0.498	0.378	**0.884**					
Interoperability	0.643	0.500	0.375	0.471	0.546	**0.823**				
Satisfaction	0.504	0.671	0.482	0.367	0.817	0.516	**0.860**			
Seamlessness	0.301	0.160	0.239	0.127	0.118	0.155	0.106	**0.773**		
Telepresence	0.436	0.456	0.281	0.355	0.533	0.497	0.524	0.265	**0.849**	
Perceived usefulness	0.520	0.587	0.411	0.440	0.677	0.622	0.616	0.115	0.525	**0.798**

〈Table 3-7〉 Discriminant validity - loading and cross-loading criterion.

	1	2	3	4	5	6	7	8	9	10
Tel1	**0.822**	0.413	0.281	0.365	0.312	0.444	0.189	0.326	0.371	0.419
Tel2	**0.892**	0.418	0.207	0.389	0.299	0.441	0.267	0.450	0.515	0.482
Tel3	**0.830**	0.437	0.192	0.356	0.295	0.453	0.253	0.380	0.440	0.452
Int1	0.458	**0.815**	0.174	0.527	0.356	0.548	0.273	0.447	0.415	0.475
Int2	0.418	**0.841**	0.093	0.537	0.386	0.522	0.280	0.392	0.401	0.438
Int3	0.389	**0.836**	0.143	0.559	0.355	0.469	0.369	0.433	0.460	0.450
Int4	0.366	**0.800**	0.095	0.493	0.459	0.503	0.318	0.372	0.423	0.434
Seam1	0.195	0.153	**0.741**	0.282	0.147	0.059	0.181	0.134	0.097	0.054
Seam2	0.226	0.102	**0.721**	0.178	0.011	0.025	0.147	0.073	0.080	0.038
Seam3	0.218	0.077	**0.793**	0.228	0.110	0.137	0.149	0.121	0.054	0.121
Seam4	0.198	0.149	**0.832**	0.231	0.087	0.095	0.248	0.145	0.103	0.117
Con1	0.339	0.521	0.254	**0.807**	0.404	0.354	0.355	0.401	0.388	0.391
Con2	0.396	0.520	0.235	**0.796**	0.412	0.455	0.369	0.407	0.421	0.385
Con3	0.314	0.510	0.239	**0.807**	0.398	0.437	0.374	0.417	0.404	0.384
EF1	0.317	0.485	0.067	0.463	**0.881**	0.473	0.258	0.350	0.361	0.405
EF2	0.302	0.347	0.152	0.410	**0.849**	0.310	0.144	0.261	0.287	0.253
EF3	0.304	0.366	0.130	0.431	**0.872**	0.328	0.150	0.297	0.292	0.298
PU1	0.429	0.499	0.167	0.362	0.411	**0.806**	0.274	0.464	0.471	0.563
PU2	0.437	0.461	0.052	0.400	0.296	**0.783**	0.365	0.469	0.565	0.547
PU3	0.387	0.464	0.032	0.406	0.319	**0.799**	0.327	0.458	0.469	0.505
PU4	0.421	0.559	0.115	0.492	0.380	**0.805**	0.344	0.482	0.457	0.546
PEU1	0.188	0.238	0.162	0.304	0.112	0.307	**0.835**	0.348	0.339	0.371
PEU2	0.232	0.324	0.187	0.392	0.199	0.356	**0.841**	0.440	0.455	0.448
PEU3	0.183	0.260	0.263	0.336	0.120	0.266	**0.805**	0.329	0.358	0.340
PEU4	0.295	0.381	0.181	0.440	0.265	0.393	**0.797**	0.485	0.409	0.448
CF1	0.427	0.440	0.133	0.444	0.309	0.567	0.467	**0.855**	0.568	0.552
CF2	0.363	0.420	0.119	0.394	0.288	0.467	0.412	**0.883**	0.577	0.504
CF3	0.402	0.450	0.166	0.491	0.332	0.499	0.425	**0.883**	0.613	0.546
Sat1	0.396	0.478	0.071	0.429	0.301	0.490	0.395	0.556	**0.849**	0.719
Sat2	0.441	0.452	0.109	0.441	0.370	0.542	0.460	0.630	**0.870**	0.704
Sat3	0.515	0.401	0.094	0.432	0.274	0.557	0.388	0.544	**0.862**	0.686
IU1	0.457	0.456	0.113	0.426	0.304	0.599	0.440	0.513	0.737	**0.891**
IU2	0.485	0.520	0.079	0.417	0.355	0.602	0.439	0.557	0.749	**0.903**
IU3	0.471	0.473	0.122	0.433	0.345	0.597	0.443	0.556	0.681	**0.858**

* 1: telepresence, 2: interoperability, 3:seamlessness, 4: concurrence, 5: economy flow, 6: Perceived Usefulness, 7: Perceived Ease of use, 8: Confirmation, 9: Satisfaction, 10: Intention to use

3.4.2 PLS Path Modeling and Hypotheses Testing

Prior to conducting the evaluation of the structural model, it is necessary to assess the presence of multicollinearity in order to assure the validity of the obtained results. According to Hair and Lukas (2014), the Variance Inflation Factor (VIF) values observed in the model were all below 5, ranging from 1.369 to 2.482. This suggests that there is no evidence of multicollinearity present in the model. Subsequently, the structural model underwent evaluation by the bootstrapping technique, employing 5,000 resamples, in order to assess the statistical significance of the hypotheses (refer to 〈Table 3-8〉).

〈Table 3-8〉 Results of hypothesis testing.

Hypo	Path	β	s.e.	t-value	p-value	Result
H1	ease of use → usefulness	0.092	0.060	1.542	0.123	Not Supported
H2	usefulness → intention	0.263	0.039	6.810	0.000	Supported
H3	ease of use → intention	0.096	0.039	2.466	0.014	Supported
H4	confirmation → usefulness	0.256	0.064	3.979	0.000	Supported
H5	confirmation → ease of use	0.499	0.043	11.467	0.000	Supported
H6	confirmation → satisfaction	0.415	0.061	6.754	0.000	Supported
H7	usefulness → satisfaction	0.312	0.056	5.583	0.000	Supported

H8	ease of use → satisfaction	0.148	0.055	2.678	0.007	Supported
H9	satisfaction → intention	0.609	0.041	15.036	0.000	Supported
H10	telepresence → usefulness	0.199	0.042	4.684	0.000	Supported
H11	telepresence → confirmation	0.232	0.068	3.426	0.001	Supported
H12	interoperability → usefulness	0.295	0.050	5.872	0.000	Supported
H13	interoperability → confirmation	0.196	0.070	2.789	0.005	Supported
H14	seamlessness → usefulness	−0.071	0.067	1.060	0.289	Not Supported
H15	seamlessness → confirmation	−0.017	0.053	0.313	0.755	Not Supported
H16	concurrence → usefulness	0.039	0.070	0.549	0.583	Not Supported
H17	concurrence → confirmation	0.261	0.068	3.831	0.000	Supported
H18	economy flow → usefulness	0.109	0.052	2.084	0.037	Supported
H19	economy flow → confirmation	0.051	0.066	0.776	0.438	Not Supported

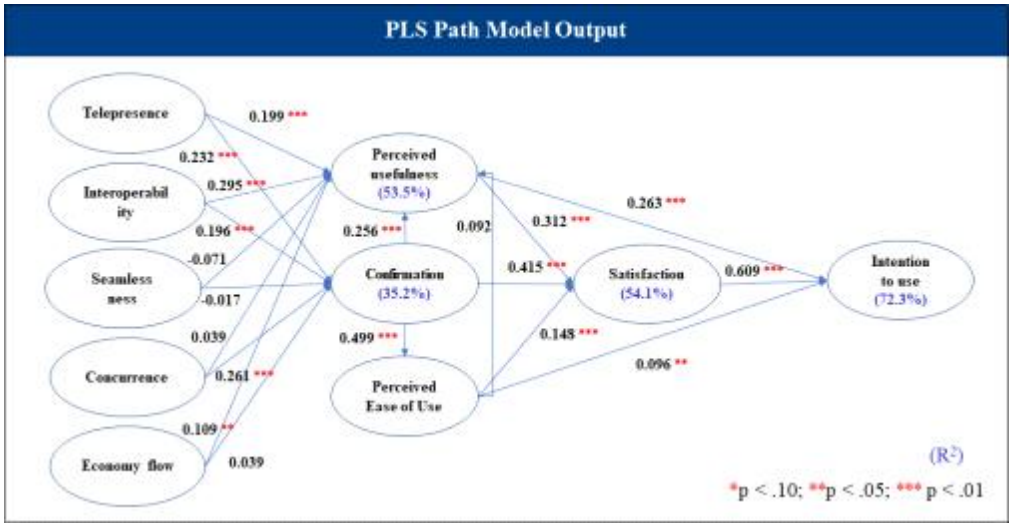
Almost all hypotheses related to TAM were supported. Hypothesis 2~3 was supported, revealing that Perceived Usefulness (β =0.263, t=6.810, p=0.000) and Perceived Ease of Use (β =0.096, t=2.466, p=0.014) were positively associated with Intention to Use. However, Hypothesis 1 was not supported, indicating that Perceived Ease of Use (β =0.092, t=1.542, p=0.123) was not positively related to Perceived Usefulness.

All hypotheses related to ECM were supported. Hypothesis 4~5 were supported, indicating that Confirmation (β =0.256, t=3.979, p=0.000) was positively related to Perceived Usefulness and Confirmation (β =0.499, t=11.467, p=0.000) was positively related

to Perceived Ease of Use. Hypothesis 6~8 was supported, revealing that Confirmation (β =0.415, t=6,754, p=0.000), Perceived Usefulness (β =0.312, t=5.583, p=0.000) and Perceived Ease of Use (β =0.148, t=2.678, p=0.007) were positively associated with Satisfaction. Meanwhile, Hypothesis 9 was supported, indicating that Satisfaction (β =0.609, t=15.036, p=0.000) was positively related to Intention to Use.

Hypotheses about the effects of Metaverse characteristics on Perceived Usefulness and Confirmation were partially supported and partially rejected. The results show that Telepresence was positively associated with Perceived Usefulness (β =0.199, t=4.684, p=0.000) and Confirmation (β =0.232, t=3.426, p=0.001). Interoperability had a significant effect on Perceived Usefulness (β =0.295, t=5.872, p=0.000) and Confirmation (β =0.196, t=2.789, p=0.005). Meanwhile, Seamlessness was not positively related to Perceived Usefulness (β =−0.071, t=1.060, p=0.289) and Confirmation (β =−0.017, t=0.313, p=0.755). On the other hand, Concurrence did not show a significant positive relationship with Perceived Usefulness(β =0.039, t=0.549, p=0.583), but it showed a significant positive relationship with Confirmation(β =0.261, t=3.381, p=0.000). Economy Flow had a significant effect on Perceived Usefulness (β =0.109, t=2.084, p=.037), but not on Confirmation (β =.051, t=0.776, p=0.438). Therefore, H10, H11, H12, H13, H17 and H18 were supported but H14, H15, H16 and H19 were not supported.

〈Figure 3-2〉 Partial Least Squares (PLS) Output



3.4.3 QCA

3.4.3.1 Analysis of necessary conditions

Although the analysis of sufficient conditions is at the core of fsQCA, it should always be preceded by the identification of necessary conditions (Schneider & Wagemann, 2010). This study analyzes the two endogenous variables, perceived usefulness and confirmation in the SEM model (see 〈Fig. 3-2〉), as outcome conditions. As in the SEM model, the fsQCA analysis considers five antecedent conditions for the outcomes, perceives usefulness and confirmation (telepresence, interoperability, seamlessness, concurrence, economy flow). To identify whether any of the five conditions are necessary for perceives usefulness or confirmation, respectively, the study analyzes whether the condition is always present (or absent) in all cases where the outcome is present (or absent) (Rihoux & Ragin, 2009). Therefore, perceives usefulness or confirmation is achievable if the condition in question occurs. The degree to which the cases

conform to this rule reflects "consistency." A condition is "necessary" or "almost always necessary" when the corresponding consistency score exceeds the threshold of 0.9 or 0.8, respectively (Ragin, 2000). 〈Table 3-9〉 presents the results of the fsQCA test on the necessity of the conditions relative to both the perceives usefulness and confirmation outcomes. The results show that no conditions are necessary conditions for perceives usefulness and confirmation.

〈Table 3-9〉 Analysis of Necessity

Condition	Usefulness		Confirmation	
	Consistency	Coverage	Consistency	Coverage
telepresence	0.7462	0.8134	0.7316	0.8000
~telepresence	0.5449	0.5680	0.5676	0.5935
interoperability	0.7919	0.8224	0.7723	0.8046
~interoperability	0.5267	0.5763	0.5479	0.6015
seamlessness	0.7192	0.8244	0.7245	0.8331
~seamlessness	0.5961	0.5935	0.5971	0.5964
concurrence	0.6898	0.7054	0.7132	0.7316
~concurrence	0.5916	0.6582	0.5791	0.6463
economy flow	0.7669	0.7894	0.7593	0.7840
~economy flow	0.5330	0.5889	0.5509	0.6105

3.4.3.2 Analysis of sufficient conditions

The analysis of sufficient conditions starts with the construction of a truth table (Ragin, 2008). The truth table has 2^k rows (k = number of conditions), and each row in the table corresponds to a configuration of conditions. Based on the set membership scores, each observation is in a particular row. The study uses the fsQCA algorithm to produce the truth tables for each of the two outcomes,

perceives usefulness and confirmation (see 〈Table 3-10〉). To reduce the truth tables to meaningful configurations, the study uses a frequency threshold of five observations (Rihoux & Ragin, 2009) to exclude less important configurations. In addition, the QCA literature also recommends that at least 80% of the cases in the sample should remain after imposing the frequency restriction (Ragin, 2008). The frequency threshold ensures that 80% of the cases in the sample are part of the analyses for perceives usefulness and confirmation, respectively. In the next step, to identify which configurations are sufficient for achieving the outcomes, the study applies a consistency threshold that is greater than or equal to 0.80 (Ragin, 2008) with a PRI score threshold that is greater than or equal to 0.70 to avoid simultaneous subset relations of attribute combinations in both the outcomes and their negations(Schneider & Wagemann, 2012). Further, when applying these threshold values, the fsQCA software provides three solutions: an intermediate solution, a parsimonious solution, and a complex solution. This study analyzes the complex solutions 〈Table 3-10〉 for both outcomes, as these solutions make no simplifying assumptions (Ragin, 2008). The consistency and coverage values for each complex solution and their respective configurations surpass the minimum acceptable values (Ragin, 2008).

3.4.3.2.1 Causal recipes for perceived usefulness

The results show that four different configurations explain perceived usefulness, and all of them consist of combinations of causal conditions. The first two indicate that high levels of telepresence combined with high levels of interoperability can lead to perceived usefulness if high value of concurrence (configuration 1)

or high value of economy flow (configuration 2). The last two indicate that high levels of concurrence combined with high levels of economy flow can lead to perceived usefulness if high value of telepresence (configuration 3) or high value of interoperability (configuration 4).

3.4.3.2.2 Causal recipes for confirmation

The results show that five different configurations explain expectation confirmation, and all of them consist of combinations of causal conditions. The first two indicate that high levels of telepresence combined with high levels of concurrence can lead to confirmation if high value of interoperability (configuration 1) or high value of seamlessness (configuration 2). The last two indicate that high levels of telepresence combined with high levels of economy flow can lead to confirmation if high value of interoperability (configuration 4) or high value of concurrence (configuration 5). The third configuration shows that confirmation also occurs when interoperability is high and seamlessness is high and concurrence is high (configuration 3).

〈Table 3-10〉 Analysis of Sufficiency(Complex solutions for outcome conditions)

model : Usefulness = f(telepresence, interoperability, concurrence, seamlessness, economy flow)			
Causal Configuration	raw coverage	unique coverage	consis-tency
telepresence*interoperability*concurrence	0.5513	0.0516	0.9210
telepresence*interoperability*economy flow	0.5601	0.0604	0.9292
telepresence*concurrence*economy flow	0.5317	0.0320	0.9266
interoperability*concurrence*seamlessness *economy flow	0.4731	0.0507	0.9300
solution coverage: 0.694356			
solution consistency: 0.895487			

model : Confirmation = f(telepresence, interoperability, concurrence, seamlessness, economy flow)			
Causal Configuration	raw coverage	unique coverage	consis -tency
telepresence*interoperability*concurrence	0.5479	0.0136	0.9183
telepresence*concurrence*seamlessness	0.4893	0.0079	0.9174
interoperability*concurrence*seamlessness	0.5261	0.0673	0.9102
telepresence*interoperability*economy flow	0.5536	0.0588	0.9212
telepresence*concurrence*economy flow	0.5281	0.0106	0.9233
solution coverage: 0.715131			
solution consistency: 0.888531			

〈Table 3-11〉 Configurations for high usefulness

Variable	High Usefulness			
	1	2	3	4
telepresence	●	●	●	
interoperability	●	●		●
seamlessness				●
concurrence	●		●	●
economy flow		●	●	●
consistency	0.9210	0.9292	0.9266	0.9300
Unique coverage	0.0516	0.0604	0.0320	0.0507
Raw coverage	0.5513	0.5601	0.5317	0.4731
Overall consistency	0.8955			
Overall coverage	0.6944			

〈Table 3-12〉 Configurations for high confirmation

Variable	High Confirmation				
	1	2	3	4	5
telepresence	●	●		●	●
interoperability	●		●	●	
seamlessness		●	●		
concurrence	●	●	●		●
economy flow				●	●
consistency	0.9183	0.9174	0.9102	0.9212	0.9233
Unique coverage	0.0136	0.0079	0.0673	0.0588	0.0106
Raw coverage	0.5479	0.4893	0.5261	0.5536	0.5281
Overall consistency	0.8885				
Overall coverage	0.7151				

3.5. Conclusion

3.5.1 Discussion

This study empirically analyzed various acceptance factors affecting the intention to use the Metaverse by applying the Technology Acceptance Model (TAM) and Expectation Confirmation Model(ECM), i.e., the factors affecting the intention to use the Metaverse were set as Metaverse characteristics such as Telepresence, Interoperability, Seamlessness, Concurrence and Economy Flow and were tested through a structural equation model. We also conducted a qualitative comparative analysis to determine which combinations of Metaverse characteristics influence perceived usefulness and confirmation. The results are as follow.

First, Perceived Usefulness and Perceived Ease of Use were positively associated with Intention to Use. However, Perceived Ease of Use was not positively related to Perceived Usefulness. These results are consistent with those of Davis (1989). These results suggest that the more useful and easier to use a metaverse is, the more likely it is to be used. On the other hand, because a metaverse is easy to use doesn't make it more useful.

Second, Expectation confirmation of Metaverse was found to have a positive impact on perceived usefulness, perceived ease of use, and satisfaction with the metaverse. In addition, perceived usefulness and perceived ease of use were positively associated with satisfaction. Moreover, satisfaction was positively related to intention to use. These results are the same as those in studies Bhattacherjee(2001) and Hong et al.(2006).

Third, This study aims to show how the analysis of net and combinatory effects of metaverse features can improve the

understanding of perceived usefulness and confirmation. The net effects from the SEM show that telepresence, interoperability and economy flow positively relate to perceived usefulness and that the effect of interoperability is stronger. The fsQCA results provide a more nuanced understanding of how these five antecedent conditions affect perceived usefulness. For example, three out of the four configurations in the fsQCA include telepresence, interoperability, concurrence and economy flow (which is similar to SEM results), but seamlessness is also an important antecedent condition when combined with interoperability, concurrence and economy flow. Moreover, the analysis of the net effect shows an explained variance(R^2) of 53.5% for perceived usefulness while the analysis of the combinatory effects shows an overall solution coverage of 69.4% for this outcome condition. Regarding confirmation, the SEM results show that three out of the five antecedent conditions, telepresence, interoperability and concurrence, have a positive and significant effect on this outcome condition. The fsQCA findings show that four out of the five configurations in the fsQCA include telepresence and concurrence; three out of the five configurations in the fsQCA include interoperability (which is similar to SEM results). Further, the SEM shows a R^2 of 35.2% for confirmation while the fsQCA analysis shows an overall solution coverage of 71.5%.

3.5.2 Theoretical and managerial implications

The theoretical implications of this study are as follows.

First, because Metaverse research is currently in its infancy, much of the research on Metaverse is conceptual and typological; however, this study attempted to empirically verify the effect of metaverse characteristics on user acceptance through large-scale

surveys. Therefore, this study provides the basis for empirical metaverse research by examining the impact on metaverse acceptance through actual metaverse users.

Second, although there are studies on user acceptance of telepresence, interoperability, etc. in extant AR-VR studies, there are no studies on user acceptance of the five Metaverse characteristics used in this study. The five metaverse characteristics are Telepresence, Interoperability, Seamlessness, Concurrence and Economy Flow, with the addition of Seamlessness, Concurrence and Economy Flow being a distinctive contribution to existing research.

Third, this study is to analyze the impact of metaverse characteristics on user acceptance by combining ECM (Expectation Confirmation Model) with the widely used TAM (Technology Acceptance Model). Bhattacherjee (2001) applied Oliver's theory of positive or negative matching between expectations and user satisfaction in marketing-related fields to the intention to continue using information systems. To this end, Bhattacherjee combined the above expectation congruence theory with the technology acceptance model to introduce four factors to explain not only acceptance but also continuous use: Confirmation, Perceived Usefulness, User Satisfaction, and Continuous Intention to use, and established a research model that focuses on the mutual influence relationship between the factors. In this study, we included perceived ease of use from TAM in the model.

Finally, This study illustrates the complimentary nature of Partial Least Squares Structural Equation Modeling (PLS-SEM) and Qualitative Comparative Analysis (QCA) in the context of investigating the qualities of the Metaverse that contribute to its high usefulness and confirmation. This provides guidance for researchers

who wish to apply these methods to develop further explanations of Metaverse acceptability. This study showed how analyzing the net and combination effects of metaverse characteristics can improve our understanding of perceived usefulness and confirmation. SEM showed the net effect of these five characteristics on perceived usefulness and confirmation, while fsQCA provided a more nuanced understanding of how any combination of these five antecedents affects perceived usefulness and confirmation.

Based on the SEM findings that telepresence, interoperability, and economy flow positively influence the perceived usefulness of the metaverse, and that telepresence, interoperability, and concurrence positively influence expectation confirmation, and that telepresence, interoperability, concurrence, and economy flow are the main variables with a combined impact on perceived usefulness of the metaverse, and that telepresence, interoperability, and concurrence are the main variables with a combined impact on expectation confirmation, metaverse companies can leverage these results to improve their services and enhance user satisfaction. A more detailed description of how each characteristic can be leveraged follows.

First, telepresence refers to the feeling of being present in the virtual environment of the metaverse. Because telepresence is considered a crucial factor for both perceived usefulness and expectation confirmation, it is advisable for metaverse enterprises to focus the development of immersive and captivating experiences that effectively boost users' sense of presence. In order to capitalize on this attribute, metaverse companies can focus on creating immersive and realistic experiences that fully immerse users in the virtual realm. The incorporation of sophisticated visual representations, tactile

response mechanisms, and interactive components serves to augment the perception of being physically present within a virtual environment.

Second, interoperability enables seamless interaction and connectivity between different platforms, applications, and users inside the Metaverse. Interoperability is an essential prerequisite for the perceived usefulness and the expectation confirmation. Enterprises can enhance the prioritization of interoperability by ensuring that their metaverse platform exhibits compatibility with a diverse range of devices, operating systems, and pre-existing virtual worlds. By facilitating seamless connectivity and collaboration among users across diverse platforms, one may enhance user satisfaction and expand the scope of the metaverse.

Third, concurrence pertains to the capacity for several users to actively communicate and engage with one another concurrently within the metaverse. The presence of concurrence is an essential prerequisite for the occurrence of both perceived usefulness and expectation confirmation. In order to use this attribute, metaverse enterprises can prioritize the development of social encounters that foster cooperation, interaction, and the exchange of activities. This may encompass various attributes, such as the incorporation of online games, the provision of virtual social spaces, and the organization of interactive events aimed at fostering user engagement and facilitating community development.

Finally, the concept of Economy Flow pertains to the seamless and effective movement of intangible commodities, services, and monetary units inside the economic framework of the Metaverse. The enhancement of this quality can be achieved through the implementation of a well-designed and user-friendly virtual economy,

which facilitates the seamless acquisition, expenditure, and exchange of virtual assets for users. The implementation of secure and transparent transaction systems, the incentivization of user participation, and the facilitation of virtual entrepreneurship all have the potential to foster a favorable flow within the economy.

By prioritizing these attributes and incorporating them into their metaverse platforms, companies can improve user perceived usefulness and expectation confirmation. This can lead to higher user adoption, engagement, and loyalty, ultimately contributing to a company's success in the metaverse. Additionally, these findings can be used as a basis for further innovation to continually improve and expand the product to meet user preferences and needs in an evolving metaverse environment.

3.5.3 Limitations and Future Research

Within this part, we enumerate many constraints of the present investigation that warrant consideration.

First, in future research, it would be valuable to investigate the adoption resistance among individuals who have not utilized the Metaverse platform, as the current sample exclusively comprises users of the site.

Second, it is worth noting that while the primary focus of this study was the desire to use Metaverse, it would have been advantageous for the researcher to also inquire about the intention to sustain the use of

Metaverse. This suggestion is particularly relevant considering that the study sample comprised individuals who were already users of Metaverse.

Third, the present study was undertaken utilizing a synthesis of the technology acceptance model and the expectation confirmation model. However, for future investigations, it would be advantageous to incorporate supplementary validation efforts by employing diverse acceptance models, such as the Unified Theory of Acceptance and Use of technological (UTAUT) and the value-based adoption model.

Finally, metaverses have various technical characteristics such as telepresence, interoperability, seamlessness, concurrence, and economy flow, as well as personal characteristics such as social influence and self-efficacy, but this study only covered five technical characteristics of metaverses as antecedents for the combined technology acceptance model and expectation confirmation model. Hence, future research endeavors aimed at validating the causal relationship between diverse components, while taking into account the distinct attributes of metaverse, will yield more valuable insights for the advancement of metaverse technologies.

Chapter 4. Conclusion

This dissertation deals with Metaverse acceptance, consisting of three papers comparing how Metaverse characteristics are applied to each of the three acceptance models (Technology Acceptance Model, Value-based Adoption Model, and Expectation Confirmation Model).

In the first essay, an extended technology acceptance model was applied to analyze the factors affecting users' intention to use the metaverse. In other words, the factors affecting users' intention to use the Metaverse were defined as technical characteristics (telepresence, interoperability, seamlessness, concurrence, and economy flow) and personal characteristics (social influence and perceived enjoyment) from the perspective of the Extended Technology Acceptance Model. The results showed that perceived usefulness and perceived ease of use, which are antecedents of the Extended Technology Acceptance Model, influence the intention to use Metaverse, and perceived ease of use influences perceived usefulness. This was consistent with previous studies (Davis, 1989; Venkatesh & Davis, 2000). Telepresence, interoperability and economy flow were found to have a positive effect on perceived usefulness, and interoperability, seamlessness and concurrence were found to have a positive effect on perceived ease of use. In addition, social influence and perceived enjoyment had a positive effect on intention to use the Metaverse. This was consistent with previous studies (Yang & Choi, 2001; Oh, 2021).

The second essay used an extended Value-based Adoption Model to analyze the determinants affecting the intention to use Metaverse users. The determinants impacting users' intention to adopt the Metaverse were identified as technical attributes (seamlessness, concurrence, telepresence, interoperability and economy flow) and personal characteristics (self-efficacy and social influence). The results showed that perceived usefulness and perceived enjoyment were found to have a positive influence on perceived value. These results were consistent with most existing studies(Kim et. al, 2007; Lee et. al, 2021, Shin, 2021). Meanwhile, technicality and perceived fee did not have a statistically significant negative effect on perceived value. Many previous studies hypothesized that technicality would have a negative effect on perceived value and found a positive effect (Kim et. al, 2007; Lee et. al, 2021, Shin, 2021). The reason for these findings is that Metaverse is hedonic in nature, and because its users are mostly young or early adopters, they may feel that learning and using Metaverse is worth the effort, even if it is difficult. And, although not statistically significant, they feel that it is worth the cost of using Metaverse. Among the Metaverse characteristics, telepresence, interoperability, concurrence and economy flow were found to have a positive influence on perceived usefulness, and telepresence, interoperability and concurrence were found to have a positive influence on perceived enjoyment. Our findings were consistent with previous studies in which telepresence positively influenced perceived usefulness and perceived enjoyment(Lee et al., 2021; Shin, 2021; Han & Ahn, 2019) and which interoperability positively increased perceived usefulness and perceived ease of

use(Cha, 2019; Shin, 2021). Meanwhile, the NCA results indicate that telepresence, interoperability, and concurrence are necessary conditions for perceived usefulness, while concurrence is the only necessary condition for perceived enjoyment. In addition, we found that social influence and self-efficacy had a positive influence on intention to use the Metaverse. We found that Social Influence had a positive effect on Intention to Use the Metaverse. We found that the results are consistent with previous studies that social influence affects usage intention (Venkatesh et al., 2003; Choi et al., 2017; Oh, 2021). In addition, Self-efficacy had a static effect on the Intention to Use the Metaverse. These results are consistent with previous research showing that self-efficacy affects usage intention (Choi et al., 2017; Oh, 2021).

The third essay empirically analyzed various acceptance factors affecting the intention to use the metaverse by applying the combination model of the technology acceptance model (TAM) and the expectation confirmation model (ECM). The characteristics of the metaverse were described in telepresence, interoperability, seamlessness, concurrence, and economy flow. The results showed that perceived usefulness and perceived ease of use were positively associated with intention to use. However, perceived ease of use was not positively related to perceived usefulness. These results are consistent with those of Davis (1989). These results suggest that the more useful and easier to use a metaverse is, the more likely it is to be used. On the other hand, because a metaverse is easy to use doesn't make it more useful. Moreover, expectation confirmation of Metaverse was found to have a positive impact on perceived

usefulness, perceived ease of use, and satisfaction with the Metaverse. In addition, perceived usefulness and perceived ease of use were positively associated with satisfaction. Moreover, satisfaction was positively related to intention to use. These results are the same as those in studies Bhattacherjee(2001) and Hong et al.(2006). In addition, this study aims to show how the analysis of net and combinatory effects of Metaverse features can improve the understanding of perceived usefulness and confirmation. The net effects from the SEM show that telepresence, interoperability and economy flow positively relate to perceived usefulness and that the effect of interoperability is stronger. The fsQCA results provide a more nuanced understanding of how these five antecedent conditions affect perceived usefulness and expectation confirmation.

This paper analyzed the impact of metaverse characteristics on users' intention to use the metaverse using different acceptance models through three essays. To determine the superiority of the acceptance model applied to the three essays, we compared them using several methods. First, we compared the R-square and Adjusted R-square values. Second, we compared the SRMR and NFI among the model fits presented in Smart PLS.

We evaluated the R2 (adjusted R2) value for essay1. Metaverse attributes accounted for 50.0%(49.0%) of the explained variance in perceived usefulness and 23.7%(22.5%) of the explained variance in perceived ease of use. In addition, perceived usefulness, perceived ease of use, social influence, and perceived enjoyment

accounted for 61.6%(61.1%) of the explained variance in intention to use. Also, we evaluated the R2 value for essay2. Metaverse attributes accounted for 47.5%(46.7%) of the explained variance in perceived usefulness and 38.1%(37.2%) of the explained variance in perceived enjoyment; perceived usefulness, perceived enjoyment, technicality, and perceived cost accounted for 37.0%(36.2%) of the explained variance in perceived value; and perceived value, social influence, and self-efficacy accounted for 48.0%(47.5%) of the explained variance in intention to use. Also, we evaluated the R2 value for essay3. Metaverse attributes accounted for 53.5%(52.5%) of the explained variance for perceived usefulness and 35.2%(34.2%) of the explained variance for confirmation. Also, perceived Usefulness, perceived ease of use and confirmation accounted for 54.1%(53.7%) of the explained variance for satisfaction. In addition, perceived usefulness, satisfaction and perceived ease of use represented 72.3%(72.1%) of the explained variance for intention to use. As a result of comparing the R2 values for the three models, it was found that the explanatory power of the intention to use the metaverse was the highest for model 3, which combines TAM and ECM. This is because the satisfaction variable, which has a significant impact on the intention to use, is included in Model 3.

According to Dash & Paul (2021), there are many ways to view model fit in SEM, but considering the model fit presented by Smart PLS, it is possible to compare SRMR and NFI.

Standardized RMSR (SRMR).

It is calculated by dividing the fitted residuals by the standard error of the residual. The range lies between 0 to 1. The lower the value is, the better the model fit. A threshold value of 0.05 or less is accepted widely (Shi & Maydeu-Olivares, 2020; Maydeu-Olivares et al., 2018). A value of up to 0.08 is also considered acceptable (Hu & Bentler, 1999; Dash & Paul, 2021).

Normed fit index (NFI).

This index evaluated the model by comparing the chi-square value of the model and the same null model or independence model (Bentler & Bonett, 1980). The null model means that all the measured variables/ indicators are uncorrelated, usually the worst possible scenario. Hence, the improvement can be assessed by considering NFI. A threshold value of 0.90 and above suggests a good model fit. Some studies recommended 〉 0.95 (Hu & Bentler, 1999). However, it is again highly affected by sample size; hence it cannot be considered alone(Dash & Paul, 2021).

Essay 1 has an SRMR of 0.060 and an NFI of 0.740, Essay 2 has an SRMR of 0.057 and an NFI of 0.721 and Essay 3 has an SRMR of 0.057 and an NFI of 0.755. The smaller the SRMR and the larger the NFI, the better, so we can see that Essay 3 has the best model.

The contributions of this study are as follows. First, because Metaverse research is currently in its infancy, the majority of the research on Metaverse is conceptual and typological; however, this study provides a foundation for empirical Metaverse research by evaluating its impact on Metaverse acceptance among actual

Metaverse users. Second, this study aims to investigate the determinants of intention to adopt Metaverse among current users, considering the current stage of Metaverse technology development. The factors influencing intention to use are analyzed by categorizing them into two primary dimensions: technology characteristics (telepresence, interoperability, seamlessness, concurrence, and economy flow) and personal characteristics (social influence, perceived enjoyment and self-efficacy). Third, while there have been studies on user acceptance of telepresence, interoperability, etc. in existing AR-VR studies, there have been no studies on Metaverse user acceptance of the five Metaverse characteristics used in this study. Fourth, various acceptance models (TAM(Technology Acceptance Model), VAM(Value-based Adoption Model), ECM(Expectation Confirmation Model)) were used to investigate the effect of Metaverse characteristics on user acceptance. As a result of comparing the R^2 values for the three models, it was found that the explanatory power of the intention to use the metaverse was the highest for model 3, which combines TAM and ECM. This is because the satisfaction variable, which has a significant impact on the intention to use, is included in Model 3. Fifth, PLS-SEM, a quantitative analysis, was used as the primary analysis methodology, and qualitative methodologies (NCA(Necessary Condition Analysis), QCA(Qualitative Comparative Analysis)) were used to compensate for this.

This section lists some limitations of this study that should be taken into account. First, since the sample consisted of users who have used the Metaverse platform, it would be useful to study

adoption resistance among non-users of the Metaverse platform in the future. Second, early adoption models mainly used usage intention as the dependent variable, while post acceptance model used continuance intention as the dependent variable. In this study, we used the intention to use with the intention to continue using, but in future studies, it would be better to analyse the intention to use and the intention to continue using separately. Third, the present study was conducted utilizing TAM(Technology Acceptance Model), VAM(Value-based Adoption Model) and ECM(Expectation Confirmation Model). However, it is recommended that future research endeavors incorporate supplementary validation efforts by employing alternative acceptance models, such as UTAUT(Unified Theory of Acceptance and Use of Technology). Fourth, the Metaverse has a variety of technical characteristics, including telepresence, interoperability, seamlessness, concurrence and economy flow, and personal characteristics, including social influence, self-efficacy and perceived enjoyment but this study covered only five technical factors and three personal factors by synthesizing previous studies on acceptance models. Therefore, if future studies verify the influence relationship between various factors considering the unique characteristics of the Metaverse, it will provide more useful implications for the development of Metaverse technology. Fifth, While we defined interoperability as the connection between the real world and the data in the Metaverse so that the results of users' experiences and actions in the Metaverse are linked to the real world, and information from the real world can be leveraged to make the experience in the Metaverse ecosystem more convenient, the survey items "The Metaverse improves communication with others," "The Metaverse promotes interaction with others," and "The Metaverse

enables the sharing of various information with others." "Giving and receiving information is active in the Metaverse." were measured with slightly different items from the definition. In future research, it is hoped that this can be further improved by creating a survey with a higher level of agreement between the definitions and measures and examining the relationship with other variables. Finally, using the same data set to analyze Metaverse characteristics and intention to use Metaverse using different acceptance models, we found that the relationship between concurrence and perceived usefulness varied across essays, although other Metaverse characteristics were not affected. For example, essays 1 and 3 did not show a significant positive relationship between concurrence and perceived usefulness, but essay 2 showed a weak but significant positive relationship. The reason for this result is that the structural equation model includes several variables together, so even if the multicollinearity test shows that there is no problem, the results are affected by the relationship between the variables. Therefore, the correlation analysis for concurrence and perceived usefulness showed a positive correlation, r=0.504, p=0.000, the regression analysis of concurrence and perceived usefulness showed a positive relationship with b=0.522, p=0.000 and the NCA (Necessary Condition Analysis) showed that concurrence was necessary for perceived usefulness with d=0.235, p=0.001. Taken together, these results suggest that concurrence has a positive relationship with perceived usefulness.

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Questionnaires

Questionnaires_Chapter1

Construct	Questionnaire
Telepresence	When using the Metaverse, I feel that I exist within the Metaverse service.
	When using the Metaverse, I feel that my mind is immersed in the Metaverse world.
	When using the Metaverse, I forget about my surroundings.
Interoperability	The Metaverse improves communication with others.
	The metaverse promotes interaction with others.
	The metaverse can share a variety of information with others.
	Sending and receiving information is active in the Metaverse.
Seamlessness	Each use of the Metaverse does not have to be based on previous experience.
	I don't need to understand new information to use Metaverse.
	I don't need to enter my information every time I use Metaverse.
	I don't have to learn a new operation every time I use Metaverse.
Concurrence	With Metaverse, you can instantly communicate with other users on topics of common interest.
	When using the Metaverse, users instantly help each other.
	When you use the Metaverse, other users can be active at the same time.
Economy Flow	Trading of products or services plays an important role in the Metaverse.
	When using the Metaverse, it is necessary to trade products or services.
	When using the Metaverse, various transaction methods of products or services play an important role.

Construct	Questionnaire
Social Influence	People around me are encouraging me to use the Metaverse.
	It's trendy to use the Metaverse.
	I use the Metaverse to keep up with the Joneses.
Perceived enjoyment	The Metaverse fuels my curiosity.
	The Metaverse stimulates my imagination.
	The Metaverse gives me fun and excitement.
	The Metaverse gives me a sense of freedom in my leisure time.
Perceived usefulness	I think the Metaverse is useful in my life.
	Using the Metaverse has practical benefits for my life, such as stress relief.
	Using the Metaverse can improve my imagination and creativity.
	I can get a lot of information from using the Metaverse.
Perceived ease of use	Using the Metaverse is easy.
	Using the Metaverse is clear and simple.
	It doesn't take a lot of time to get used to using Metaverse.
	Metaverse is easy to use anytime, anywhere.
Intention to use	I am willing to continue using Metaverse in the future.
	I am willing to use Metaverse frequently in the future.
	I would recommend using Metaverse to others.

Questionnaires_Chapter2

Construct	Questionnaire
Telepresence	When using the Metaverse, I feel that I exist within the Metaverse service.
	When using the Metaverse, I feel that my mind is immersed in the Metaverse world.
	When using the Metaverse, I forget about my surroundings.
Interoperability	The Metaverse improves communication with others.
	The metaverse promotes interaction with others.
	The metaverse can share a variety of information with others.
	Sending and receiving information is active in the Metaverse.
Seamlessness	Each use of the Metaverse does not have to be based on previous experience.
	I don't need to understand new information to use Metaverse.
	I don't need to enter my information every time I use Metaverse.
	I don't have to learn a new operation every time I use Metaverse.
Concurrence	With Metaverse, you can instantly communicate with other users on topics of common interest.
	When using the Metaverse, users instantly help each other.
	When you use the Metaverse, other users can be active at the same time.
Economy Flow	Trading of products or services plays an important role in the Metaverse.
	When using the Metaverse, it is necessary to trade products or services.
	When using the Metaverse, various transaction methods of products or services play an important role.
Social Influence	People around me are encouraging me to use the Metaverse.
	It's trendy to use the Metaverse.
	I use the Metaverse to keep up with the Joneses.

Construct	Questionnaire
Self-efficacy	I am confident in mastering skills related to the Metaverse.
	I am confident in understanding terminology related to the Metaverse.
	I am confident in explaining features related to the Metaverse.
Perceived Usefulness	I think the Metaverse is useful in my life.
	Using the Metaverse has practical benefits for my life, such as stress relief.
	Using the Metaverse can improve my imagination and creativity.
	I can get a lot of information from using the Metaverse.
Perceived Enjoyment	The Metaverse fuels my curiosity.
	The Metaverse stimulates my imagination.
	The Metaverse gives me fun and excitement.
	The Metaverse gives me a sense of freedom in my leisure time.
Technicality	I think it's hard to learn how to use the Metaverse.
	Using the Metaverse requires a lot of time and effort.
	It is difficult to get used to using the Metaverse.
	It is difficult to operate the Metaverse.
Perceived Fee	Paying to use the Metaverse is expensive.
	Using the Metaverse is more expensive than you think.
	The cost of using the Metaverse is a big burden.
	The value of using the Metaverse is not worth the cost.
Perceived Value	The cost of using the Metaverse is higher than the value you get.
	The benefits of using the Metaverse are greater than the effort required to use it.
	The rewards are greater than the time commitment required to use the Metaverse.
	Using the Metaverse brings great value to my life.
Intention to use	I am willing to continue using Metaverse in the future.
	I am willing to use Metaverse frequently in the future.
	I would recommend using Metaverse to others.

Questionnaires_Chapter3

Construct	Questionnaire
Telepresence	When using the Metaverse, I feel that I exist within the Metaverse service.
	When using the Metaverse, I feel that my mind is immersed in the Metaverse world.
	When using the Metaverse, I forget about my surroundings.
Interoperability	The Metaverse improves communication with others.
	The metaverse promotes interaction with others.
	The metaverse can share a variety of information with others.
	Sending and receiving information is active in the Metaverse.
Seamlessness	Each use of the Metaverse does not have to be based on previous experience.
	I don't need to understand new information to use Metaverse.
	I don't need to enter my information every time I use Metaverse.
	I don't have to learn a new operation every time I use Metaverse.
Concurrence	With Metaverse, you can instantly communicate with other users on topics of common interest.
	When using the Metaverse, users instantly help each other.
	When you use the Metaverse, other users can be active at the same time.
Economy Flow	Trading of products or services plays an important role in the Metaverse.
	When using the Metaverse, it is necessary to trade products or services.
	When using the Metaverse, various transaction methods of products or services play an important role.

Construct	Questionnaire
Perceived usefulness	I think the Metaverse is useful in my life.
	Using the Metaverse has practical benefits for my life, such as stress relief.
	Using the Metaverse can improve my imagination and creativity.
	I can get a lot of information from using the Metaverse.
Expectation Confirmation	My experience with Metaverse exceeded my expectations.
	The features and services of the Metaverse exceeded my expectations.
	Overall, my expectations for Metaverse were met.
Perceived ease of use	Using the Metaverse is easy.
	Using the Metaverse is clear and simple.
	It doesn't take a lot of time to get used to using Metaverse.
	Metaverse is easy to use anytime, anywhere.
Satisfaction	I am satisfied with the Metaverse.
	I enjoy using the Metaverse.
	Using the Metaverse satisfies my needs.
Intention to use	I am willing to continue using Metaverse in the future.
	I am willing to use Metaverse frequently in the future.
	I would recommend using Metaverse to others.

국 문 초 록

메타버스 수용에 관한 세 가지 소논문

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스 마 트 융 합 컨 설 팅 학 과
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본 학위논문은 메타버스 수용을 다룬 논문으로, 세 가지 수용 모델(기술 수용 모델, 가치 기반 수용 모델, 기대 확인 모델) 각각에 메타버스 특성이 어떻게 적용되는지를 비교한 3편의 논문으로 구성되어 있다.

첫 번째 소논문은 확장된 기술 수용 모델을 적용하여 사용자의 메타버스 사용 의도에 영향을 미치는 요인을 분석하였다. 즉, 확장된 기술수용모델의 관점에서 메타버스 이용의도에 영향을 미치는 요인을 기술적 특성(원격실재감, 상호운용성, 연속성, 동시성, 경제흐름)과 개인적 특성(사회적 영향력, 지각된 즐거움)으로 정의하고, 메타버스 이용의도에 영향을 미치는 요인들을 분석하였다. 그 결과 확장된 기술 수용 모델의 선행 요인인 지각된 유용성과 지각된 사용 용이성이 메타버스 사용 의도에 영향을 미치고, 지각된 사용 용이성은 지각된 유용성에 영향을 미치는 것으로 나타났다. 원격실재감, 상호운용성, 경제성 흐름은 인지된 유용성에 긍정적인 영향을 미치는 것으로 나타났으며, 상호운용성, 연속성, 동시성은 인지

된 사용 용이성에 긍정적인 영향을 미치는 것으로 나타났다. 또한 사회적 영향력과 지각된 즐거움은 메타버스 사용 의도에 긍정적인 영향을 미치는 것으로 나타났다.

두 번째 소논문은 확장된 가치기반 수용모형을 활용하여 메타버스 사용자의 사용의도에 영향을 미치는 결정요인을 분석하였다. 사용자의 메타버스 채택의도에 영향을 미치는 결정요인은 기술적 속성(연속성, 동시성, 원격실재감, 상호운용성 및 경제흐름)과 개인적 특성(자기효능감 및 사회적 영향력)으로 확인되었다. 그 결과 지각된 유용성과 지각된 즐거움은 지각된 가치에 긍정적인 영향을 미치는 것으로 나타났다. 한편 기술성과 지각된 비용은 지각된 가치에 통계적으로 유의한 부정적인 영향을 미치지 않았다. 메타버스 특성 중 원격실재감, 상호운용성, 동시성 및 경제흐름은 지각된 유용성에 긍정적인 영향을 미치는 것으로 나타났고, 원격실재감, 상호운용성 및 동시성은 지각된 즐거움에 긍정적인 영향을 미치는 것으로 나타났다. 한편 NCA 결과는 원격실재감, 상호운용성 및 동시성이 지각된 유용성에 필요조건인 반면 동시성은 지각된 즐거움에 필요조건인 것으로 나타났다. 또한 사회적 영향력과 자기효능감이 메타버스 사용의도에 긍정적인 영향을 미치는 것으로 나타났다.

세 번째 소논문은 기술수용모형(TAM)과 기대확인모형(ECM)의 결합모형을 적용하여 메타버스 이용의도에 영향을 미치는 다양한 수용요인을 실증적으로 분석하였다. 메타버스의 특성은 원격실재감, 상호운용성, 연속성, 동시성, 경제흐름으로 기술된다. 지각된 유용성과 지각된 사용 용이성은 사용의도와 긍정적으로 연관되는 것으로 나타났다. 반면, 지각된 사용 용이성은 지각된 유용성과 긍정적으로 연관되지 않았다. 반면, 메타버스의 기대 확인은 메타버스에 대한 지각된 유용성, 지각된 사용 용이성, 만족도에 긍정적으로 영향을 미치는 것으로 나타났다. 또한 본 연구는 메타버스 특성의 순효과 및 조합효과 분석이 지각된 유용성 및 기대확인에 대한 이해를 어떻게 향상시킬 수 있는지 보여주는 것을 목적으로 한다. SEM의 순효과는 원격실재감, 상호운용성 및 경제 흐름이 지각된 유용성과 긍정적인 관련이 있으며 상호운용성의 효과가 더 강함을 보여주었다. fsQCA

결과는 이러한 다섯 가지 선행조건이 지각된 유용성 및 기대 확인에 어떤 영향을 미치는지에 대해 보다 미묘한 이해를 제공하였다.

본 논문의 공헌점은 다음과 같습니다. 첫째, 메타버스 연구는 현재 초기 단계이기 때문에 메타버스에 대한 연구의 상당 부분이 개념적이고 유형적이지만, 본 연구는 실제 메타버스 사용자를 통해 메타버스 수용에 미치는 영향을 살펴봄으로써 실증적 메타버스 연구의 토대를 제공하였다. 둘째, 본 연구는 메타버스 기술개발의 현 단계를 고려하여 현재 사용자들의 메타버스 채택의도 결정요인을 규명하고자 하였다. 채택의도에 영향을 미치는 요인은 크게 두 가지 차원, 즉 기술특성(원격실재감, 상호운용성, 연속성, 동시성, 경제흐름)과 개인특성(사회적 영향력, 지각된 즐거움, 자기효능감)으로 분류하여 분석하였다. 셋째, 기존 AR-VR 연구에서 원격실재감, 상호운용성 등의 사용자 수용에 관한 연구가 있는 반면, 본 연구에서 사용된 5가지 메타버스 특성에 대한 메타버스 사용자 수용에 관한 연구는 전무한 실정이다. 넷째, 메타버스 특성이 사용자 수용에 미치는 영향을 살펴보기 위해 다양한 수용모형(TAM(Technology Acceptance Model), VAM(Value-based Adoption Model), ECM(Expectation Confirmation Model))을 활용하였다. 다섯째, 정량분석인 PLS-SEM을 기본 분석방법론으로 활용하였으며, 이를 보완하기 위해 정성적 방법론(NCA(Necessary Condition Analysis), QCA(Qualitative Comparative Analysis))를 활용하였다. 마지막으로 메타버스 특성(원격실재감, 상호운용성, 연속성, 동시성, 경제흐름)이 사용자 의도에 미치는 영향에 관한 연구결과를 바탕으로 기업의 메타버스 서비스 제고 및 사용자 만족도 향상을 위한 경영적 시사점을 제공하는 데 활용된다.

【주요어】원격실재감, 상호운용성, 연속성, 동시성, 경제흐름, 기술, 수용모델, 가치기반수용모델, 기대확인모델, 필요조건분석, 질적비교분석