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Understanding of the Metaverse Industry and Policy Challenges

Jahyeon Koo, Changgeun Lee,
Jihye Park, Sohyeon Park, Gayeong Lee,
Hyeondo Lee, Minseop Yoon

KDI Korea Development Institute

INNOVATION CENTRE DENMARK Develop in collaboration with Innovation Centre Denmark Seoul

Contents

◈ Tables

◈ Figures

Chapter 1

Introduction

Section 1 Emergence of the Metaverse

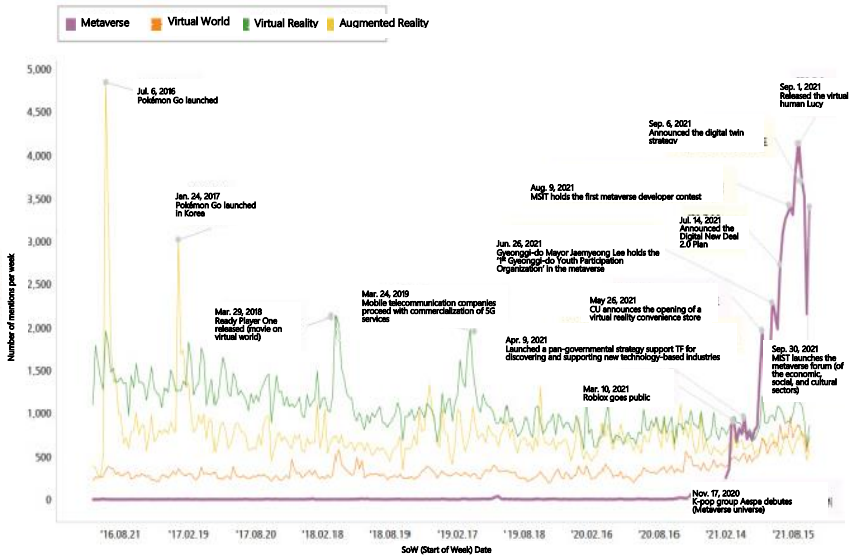
Since 2020, "metaverse" has become one of the most frequently used words in the media. Metaverse-related companies have emerged as promising investment targets in the stock market while various sectors, including finance, manufacturing, and entertainment, are making efforts to associate with the metaverse. Global big tech companies such as Microsoft, Apple, and Facebook are already on their way to transforming and expanding their business models through the metaverse. Facebook recently announced that it would change its name to 'Meta,' officially declaring its transition from a social media company to a metaverse company.[1] Microsoft announced the development of a new platform combining its platform Mesh and its collaboration tool Teams for a metaverse that connects various worlds together[2].

Metaverse is a term that first appeared in Neal Stephenson's 1992 novel, Snow Crash, dubbed to mean a three-dimensional virtual world where people use Avatars to act for themselves. The metaverse started to materialize in the real world with the advent of the Second Life, a 3D virtual space in 2003, and Google Earth, a 3D map service from Google in 2006. However, it came to the spotlight somewhat recently.

[Figure 1-1] illustrates the weekly mentions of metaverse-related issues on online media channels e.g. news, SNS, YouTube, etc., from June 1, 2016, to September 26, 2021. There were few mentions of the metaverse prior to 2020 in contrast to the growing interest in technological elements like augmented reality (AR) and virtual reality (VR). However, the metaverse began attracting attention in the second half of 2020, riveting in February and March 2021, peaking around August 2021 with the release of the virtual human Lucy. Everyone is paying more attention to the extensive new term of the metaverse than specific technologies such as VR and AR.

[1] Connect 2021(https://www.youtube.com/watch?v=Uvufun6xer8&t=482s). Oct. 29, 2021
[2] Microsoft Ignite 2021(https://news.microsoft.com/november-2021-ignite/). Nov. 3, 2021

[Figure 1-1] Mentions of the word metaverse



Note: The analysis was conducted using Some Trend Biz, an ASP service providing the trends in comments and relevant words concerning matters of interest by collecting documents from various online platforms such as news and SNS.
Source: Data Analysis Team, Economic Information Center, KDI (https://eiec.kdi.re.kr/issue/snsdataView.do?idx=1487&pp=20&pg=1, Access Date: Nov. 26, 2021).

At this point, the metaverse is increasingly attracting interest and spreading to various fields for the following reasons.

First, the ability to realize virtual worlds improved dramatically with the development of technologies such as virtual reality (VR), augmented reality (AR), 5G, and blockchain. The point is that individual technologies have been advanced, with services converging these technologies appearing. In 2019, the concept of the immersive economy[3] became the focus of a new economic trend during which it became natural to solve social and economic issues in another world, the metaverse. The Korean government is also working to increase immersive technology experiences and build an XR-based economy[4]. However, using XR technology in itself is not the only core element of the metaverse. More critical factors include people's acceptance and interaction and the possibility of new economic activities.

The global COVID-19 pandemic circumstances since early 2020 accelerated the use of the Metaverse. Restrictions on travel and face-to-face communication made work and classes go on through video conferencing tools like ZOOM and hold various events with networking tools, including Zoom and Gather Town. Games like Roblox and Fortnite became spaces for

[3] Immersive economy refers to an economy applying immersive technology to create industrial, social, and cultural values. (Innovate UK (2018), "The Immersive Economy in the UK").
[4] The virtual convergence economy means creating new experiences and economic values by expanding the space for economic activities (work, leisure, and communication) from the real to the metaverse by using XR. ("Virtual Convergence Economy Vitalization Strategy," jointly announced by relevant ministries (December 10, 2020)

realizing human relationships. While the concept of avatars representing ourselves in virtual space is nothing new, it is freer and enables various interactions by combining with social networks.

In particular, the so-called MZ generation, referring to those born in the 1980s to 2000s, widely accepts the metaverse, expanding the breadth and depth of activities in virtual space. Their familiarity with products and cultural leisure in the metaverse worked as another stimulus to various services beyond the constraints of space and time in virtual space. As of 2019, the MZ generation formed a leading influence in consumption, taking up around 30% of the Korean population, 50% of the US, and 63.5% of the world, respectively.[5] The emergence of such a huge group as the driving force of the metaverse made many companies realize that the metaverse is a new world to enter.

<Table 1-1> Metaverse-related policies by major countries

Country	Details
US	- State to lead VR/AR research of core areas, including defense, disasters, medicine, and education and facilitate transfer of research results to the private sector - The US Department of Defense plans to invest $1.1 million in VR/AR training system by 2022
UK	- Announced 'Immersive Economy,' the nation's strategy for facilitating the XR industry
EU	- Focused on securing XR technology through 'Authoring Mixed Reality', 'EU 7th Framework Program', and 'Horizon 2020' since 2018
China	- Announced the guiding opinion for accelerating the VR industry and suggested VR convergence in major fields such as manufacturing, education, culture, and health as a key task
Japan	- Develop XR technologies to bring forward 'Society 5.0' - Realize XR early through 'Industrial Technology Vision 2020'
Korea	- Announced the Virtual Convergence Economy Vitalization Strategy which include 'Digital New Deal' in the Korean version of the New Deal announced in 2020 - The Ministry of Strategy and Finance announced detailed plans for fostering the 'Digital New Deal' in July 2021, planning to invest about 49 trillion won by 2025 - Proceeded with the legislation of the Virtual Convergence Industry Promotion Act in 2022, including plans to promptly support commercialization by applying tentative criteria if relevant standards are unclear

Source: Meritz Securities Report (Jul. 26, 2021) Recited. Ministry of Science and ICT, Software Policy Research Center, Meritz Securities Research Center.

Section 2 Concept and Characteristics of the Metaverse

1. Concept of the Metaverse

The US technology research organization Acceleration Studies Foundation announced the "Metaverse Roadmap" in 2007. It defined the metaverse as "a convergence of virtually-

[5] Korea Information Processing Society Journal/Software and Data Science vol. 10 no. 8 (Aug. 2021)

enhanced physical reality and physically persistent virtual space." ASF divided the Metaverse into four scenarios of Augmented Reality, Lifelogging, Mirror Worlds, and Virtual Worlds depending on the type of technology applied (augmentation, simulation) and the scope of the target (individual, environment) (see <Table 1-2>).

Lifelogging is already a common type of the Metaverse, expanded by people using it every day, and typical examples include social network services (SNS) like Instagram, Facebook, Twitter, etc. Games are the most representative of the virtual worlds that are most actively developing among the metaverse types with a significant number of existing users. Meanwhile, the technological development speed for augmented reality falls short of making it a trend, and the use of mirror worlds is limited to some industries or specific areas.

<Table 1-2> Characteristics of Metaverse scenarios

	Augmented reality	Lifelogging	Mirror worlds	Virtual worlds
Definition	An interactive environment where virtual 2D or 3D objects overlap in reality	Technology of capturing, storing and sending everyday people-to-people experiences and information	Virtual world where information projected from the real world is expanded as is	Virtual world built with digital data
Realized value (Needs)	Provides immersive content combining the real world, fantasy, and convenience	Possible to check a vast amount of experience and information in the real world at any time and share with others	Maximizes utilization by integrating and expanding external information into virtual space	Provides a new virtual space, not existing in the real world, where various individuals can engage in many activities
Core technologies	• Unstructured data processing • 3D printing • 5G network	• Online platform • Ubiquitous sensor • 5G network	• Blockchain technology • GIS systems • Data storage, 3D technology	• Graphic technology • 5G network • AI • Blockchain technology
Service examples	• Pokemon GO • HUD in front of the driver's seat • SNOW app • The Coca-Cola Project • Room escaping games • SNS activities using 3D avatars • Airbus, BMW's Augmented Reality Smart Factory	• S-health, Apple • Nike+running • Vehicle black boxes • SNS • Media blogs • Vlog, feed, etc.	• Google Earth, Naver, Kakao map • Airbnb • Minerva School • Zoom meeting rooms • Foldit Digital Lab • Baedal Minjok • Jikbang, Dabang, etc.	• Fortnite • Minecraft • Roblox • Animal Crossing • Zepeto • Burberry B Surf • Simulation platform
Major companies	• Niantic • Ingress • Microsoft • Amazon • Facebook	• Nike • Samsung, Apple • Facebook, Twitter • Microsoft • Amazon	• Google, Naver, Kakao • Airbnb • Microsoft • Amazon • Facebook	• Epic games • X-bos game studio • NaverZ • Nintendo • NC Soft • Microsoft • Facebook
Risk factors	• Confusion in augmented reality design where reality is superimposed • Ownership of characters, etc. in augmented reality	• Portrait rights and property rights infringement • Leakage of internal confidential information • Violation of side job prohibition	• Data manipulation issues • Unfair trade due to the lock-in of large-scale platforms	• Escape from the real world • Concerns about disorder that may cause moral and ethical problems

Source: Yoon, Jeong-hyeon, 「 Metaverse, crossing the boundary between virtual and real worlds 」, ªFuture Horizon Focus4, Vol. 49, 2021.

While most researchers recognized each metaverse type as presented by ASF in the early stage of metaverse research, the boundaries between the types gradually became vague, merging with each other and appearing in various forms. As the concept of the metaverse has not been clearly established yet, each researcher has more or less a different idea of its definition and scope (see <Table 1-3>). For instance, Nvidia CEO Jensen Huang declared, "The next 20 years will be no different from science fiction. The era of the metaverse is approaching," in a keynote speech at the GPU Technology Conference (GTC) on October 6, 2020. He referred to the metaverse as a 3D space where human avatars and software agents interact, a virtual reality space succeeding the Internet. Jon Radoff, CEO of Beamable, an online game development platform, explains the metaverse is the 'internet that generates creative spaces where anyone can design experiences.' Domestic researchers also suggested various concepts, mostly seeing the metaverse as a virtual world (space) for carrying out economic, social, and cultural activities connected with reality.

<Table 1-3> Definition of the Metaverse

Researcher	Definition
Son, Gang-min, et al. (2006)	A virtual world where everyone uses avatars to engage in social, economic, and cultural activities.
Ryu, Cheol-gyun · Ahn, Jin-gyeong (2007)	A virtual reality space where social and economic opportunities are provided like the real world
ASF (2007)	Convergence of virtually-enhanced physical reality and physically persistent virtual space
Seo, Seong-eun (2008)	Not a simple 3D virtual space, but the space and method itself where virtual space and reality actively interact, or another world realizing the intersection of the reality and the virtual world using 3D technology
IEEE (Institute of Electrical and Electronics Engineers) (2014)	An advanced Internet consisting of persistent 3D virtual spaces linked to a perceived virtual world
Jensen Huang (2020)	It is one where humans as avatars and software agents interact in a 3D space
Kim, Sang-gyun (2021)	A new digital earth where avatars representing us engage in productive activities
Lee, Im-bok (2021)	A virtual reality world that interacts with reality
Jon Radoff (2021)	The internet that generates creative spaces where anyone can design experiences
Cathy Hack (2021)	A virtual space and Internet where you enjoy various experiences connected to reality
Lee, Seung-hwan (2021)	A world where virtuality and reality interact and co-evolve, and social, economic, and cultural activities take place, creating value.
Mark Zuckerberg (2021)	The successor to the mobile internet, where can do new creative things with people far away no matter how far apart we are, transcending time and space as simple as clicking a link on the Internet

Source: Listed by the author

2. Major Characteristics of the Metaverse

Just as the definition of the metaverse has not yet been established, researchers have different emphases on its main characteristics. Matthew Ball (2020)[6], a former Head of Strategy at Amazon Studios who created the world's first Metaverse Exchange Traded Fund

[6] https://news.mt.co.kr/mtview.php?no=2021102116190079773, Last accessed on Oct. 24, 2021.

(ETF), pointed out 7 features of the Metaverse: persistent; synchronous and live; without any cap to concurrent users; a fully functioning economy; an experience that spans; offer unprecedented interoperability of data and content; populated by content created and operated by an incredibly wide range of contributors.[7]

Chad Richman (2020), the CEO of Clink, a US geosocial network and game platform company, described that the Metaverse is an open virtual space shared by everyone; a linkage between the digital world and the virtual world; and persistent, meaning that the Metaverse is there even when you are not.[8] Kim Sang-gyun and Shin Byung-ho (2021) called the main characteristics of the metaverse a SPICE model to represent the features of Seamlessness, Presence, Interoperability, Concurrence, and Economy Flow.[9]

Although the main features are expressed in different terms depending on the researcher, they do not differ much. Focusing on the details organized by Kim Sang-gyun and Shin Byung-ho (2021), the characteristics of the metaverse are as follows.

A. Seamlessness

This means that various experiences and records in the metaverse are seamlessly connected without being cut off. You can use a single avatar to play a game and continue shopping or discussing business without having to log in again or switch to another platform. In Fortnite, for example, the users play a battle royale game and then move directly to the party royale space to watch a performance on the same platform. The users can also go to the community space to communicate with others. Here, the point is that besides the various actions allowed on a single platform, the records are linked as well. Seamlessness is a property that connects memories and information as in the real world, rather than new connections and different characters in each place.

B. Presence

While the metaverse is an environment without actual physical contact, users feel a social and spatial presence as in the real world. In the virtual world, immersion is critical for improving presence, and equipment like VR/AR devices can help. It does not only have the technical aspects of VR and AR but should accompany a well-organized story that evokes presence: narrative.

C. Interoperability

[7] https://www.matthewball.vc/all/themetaverse, Last accessed on Oct. 24, 2021
[8] https://clink.social/what-is-the-metaverse/, Last accessed on Oct. 24, 2021
[9] Kim, Sang-gyun Shin, Byung-ho, <Metaverse, A New Opportunity>, Vegabooks, 2021.

Interoperability is a situation where the data and information of the real world and metaverse are linked, connecting the user's experience and actions in the metaverse to the actual world. Here, the metaverse experiences become richer and more convenient based on the lifelogging information in the real world.

Recently, Zepeto entered into a partnership with Sandbox, a leading NFT digital real estate platform in the US, to reinforce interoperability between platforms. Zepeto will have an area with the Sandbox theme, and a 'Zepeto world' will be created in Sandbox for the users to experience the platform in Sandbox. Each platform plans to provide unique items and goods to the other, allowing the users to learn about and get used to both.[10]

D. Concurrence

Concurrency refers to an environment where multiple users are active in one metaverse concurrently, having diverse experiences in the same time frame. A virtual reality game accessed by a single person and enjoyed according to a predefined scenario cannot be deemed a metaverse because it does not satisfy concurrency.

E. Economy Flow

An economic flow must exist for users to freely trade goods and services according to the currency and transaction method provided by the platform. It must further be linked with other metaverses or the real world.

Section 3 Structure of the Report

This report aims to examine the concept and characteristics of the metaverse presented above in the economic aspect and to forecast the future of related industries. For the purpose, the report has been structured as follows.

First, Chapter 2 examines the structure and operating principle of the metaverse as an economic system. It reviews various pieces of literature, diverse elements making up the metaverse ecosystem, and their relationships, that is, an overview of the value chain structure. It also covers the technological factors underlying this ecosystem. Based on this conceptual explanation, Chapter 3 examines cases where the metaverse is applied to various industries, including manufacturing, distribution, education, and cultural tourism. It will check how to utilize the metaverse specifically for businesses and explore what new economic possibilities it generates. Chapter 4 analyzes the economic properties and potential of the metaverse by

[10] Seong, Sora · Rolf Hoefer · Scott McLaughlin, <NFT Revolution>, The Quest, 2021

aggregating the characteristics identified through various cases. Specifically, it investigates the difference between the metaverse and the existing virtual space and whether increased economic activities in virtual space replace or expand such activities occurring offline. It will further analyze a survey of employees of Korean companies currently running the metaverse to predict its industrial potential and the changing aspects of relevant industries companies expect.

Chapter 5 draws policy implications based on the discussion so far. It first identifies areas requiring policy support focus based on the competitiveness of Korea analyzed in Chapter 4 and the expected changes in the future. It then aims to pinpoint legal issues related to economic activities in virtual space and explore the applicability of expected disputes and existing legal principles.

Chapter 2

Structure and Operating Principle of Metaverse Ecosystem

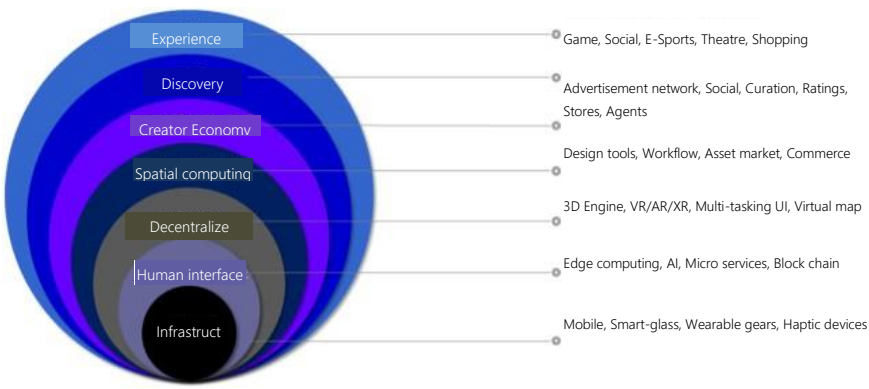
Section 1 Metaverse Value Chain

1. Key Elements of the Metaverse Ecosystem

Jon Radoff, CEO of the metaverse game platform Beamable, claims that the metaverse is not just one but a 'multiverse' toward Internet 3.0. He predicted that various virtual environments will be decentralized, where high-performance Internet technology, infrastructure, and platforms intersect and mutually function. [Figure 2-1] shows the key elements of the metaverse value chain Randoff suggested. [Figure 2-2] lists the representative companies for each element, suggesting a possible metaverse ecosystem.

Then, the focus will move on to the most basic infrastructure of the metaverse ecosystem. It will be followed by an investigation of the technical elements of human interface, decentralization, and spatial computing, and their expansion to the creator economy, discovery, and experience by classifying them into core elements. Afterward, Section 2 will describe the technical factors necessary for operating the metaverse ecosystem.

[Figure 2-1] 7 Hierarchies of the Metaverse Value Chain



Source: Jon Radoff's materials. Reconstructed by the author.

[Figure 2-2] Major Companies by Position in the Metaverse Value Chain

Source: Jon Radoff, "Market Map of the Metaverse", As updated on Nov. 24, 2021 (https://medium. com/building-the-metaverse/market-map-of-the-metaverse-8ae0cde89696, Accessed on Nov. 26, 2021).

A. Experience

Experience means actually participating in the activities taking place in the metaverse, including games, social experiences, and live music. People can have indirect experiences without restrictions of physical space, distance, or objects (so-called dematerialization) through the metaverse. For example, only a limited number of seats can be sold for a concert in a physical space, but there is no such limit for a virtual one. Fortnite, a game from Epic Games, holds movie screenings and concerts with various people from different regions participating in a 3D social space called Party Royale. The company plans to advance by integrating more events to provide information in live entertainment. Areas like travel, education, and live performances will reorganize around the virtual economy based on existing familiar experiences.

B. Discovery

In a successful metaverse, participants do not remain as simple consumers but act as producers as well. In other words, the metaverse is not limited to several events planned by the service providers, and an ecosystem where a large number of people create and distribute content and receive compensation forms around the community in virtual space like YouTube.

A system evaluating experiences of various content, recommending them to users, and compensating creators according to this evaluation can be summed up as 'discovery.' It

includes ad networks, social, curation, ratings, stores, and agents. Community-centered content can be assessed more efficiently than existing one-way marketing. The easier it is to exchange, trade, and share within the metaverse, the more it becomes a marketing asset. Features like real-time linkage and notifications consistently help us discover new experiences and potential content.

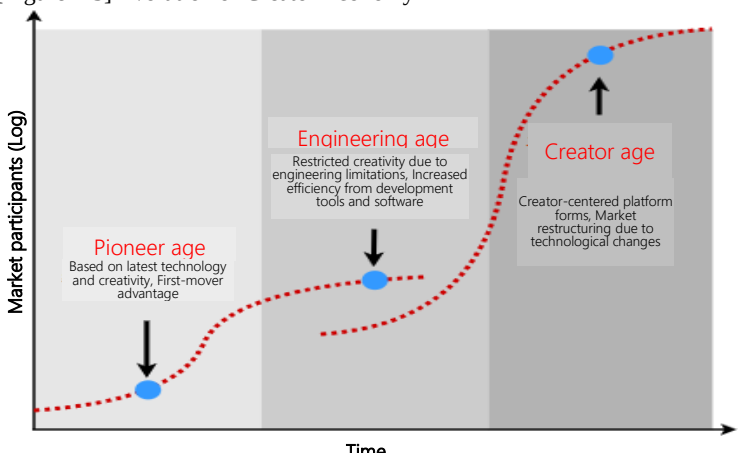
Means such as NFT (Non-Fungible Token: Non-Fungible Token) provide the basis for metaverse users, who are consumers and creators at the same time, to record their content in a unique form and to trade in the market. This further encourages creators' participation.

C. Creator Economy

The Creator Economy includes everything that helps creators make things for and profit from the Metaverse, e.g. design tools, animation systems, graphics tools, and profit-generating technologies. The success of the metaverse depends on immersion and gripping content and experience. To this end, the number of creators desiring to be evaluated and rewarded by the community must increase.

[Figure 2-3] depicts the increasing number of creators in the ideally progressing metaverse. In the early stage or the so-called 'pioneer era,' games, web development, e-commerce, etc. are implemented individually through HTML-based coding. Therefore, technical capabilities are required to create content, and it is still difficult for many people to jump into creation. As the technology matures, various open-source languages and company SDKs or API services are provided, making it more efficient to create content. This is a phase where more people can participate despite existing technical constraints, the so-called engineering era.

[Figure 2-3] Evolution of Creator Economy



Source: Jon Radoff's materials. Reconstructed by the author.

The creator economy will eventually evolve into the creator era, where creator-centered tools are developed, and many people participate in creation. Creators will be able to create content and experiences more efficiently using these tools instead of coding or detailed optimization. You can start an e-commerce website on Shopify in minutes without knowing how to code or create and maintain a website on Wix or Squarespace. You can create 3D graphics experiences within game engines like Unity and Unreal without dealing with the rendering API using a visual interface in a studio setting.

D. Spatial Computing

Spatial computing is a term first used by Simone Greenwood, an MIT Media Lab graduate, in a paper published in 2003. It refers to the process of using digital technology for computers to interact seamlessly in a 3D world using VR, AR, XR, etc.[11] For the convergence of the real and the virtual, the core of the metaverse, spatial computing must be processed accurately and efficiently. Here, data (coordinates, voice, etc.) and AI for spatial computing, and a 3D engine to efficiently process them are vital. Specifically, required software includes 3D engines (Unity and Unreal) for displaying geometry and animation and next-generation user interfaces supporting internal and external world mapping and interpretation (geospace mapping and object recognition), voice and gesture recognition, devices (IoT) data integration and human biometrics recognition, simultaneous information streams, and analytics.

Spatial computing is a generic concept referring to the computing technologies that enable the realization of the metaverse and technology that connects objects and spatial locations in the real world by combining a part or all of the technologies. Spatial computing is bursting into a technology that enables users to enter and manipulate 3D space and augment the real world based on more information and experience.

E. Decentralized

An ideal metaverse will be a system of an open technical structure that enable interoperability between systems and allow creators to have sovereignty over their data and creations. In such an environment, developers may utilize all online features, from commerce systems to purpose-built AI to various game systems, without having to define communication and connection methods and worry about the compatibility of detailed features.

Decentralization is also evident in terms of payment, i.e. various blockchain-based coins and NFTs support microtransactions in the metaverse without a central exchange.

[11] Naver Blog, https://blog.naver.com/smartnari/222565130927, Accessed on Nov. 26, 2021

F. Human Interface

Human interface is a broad term for technology that allows humans to transfer data to machines. It refers to the hardware providing access to the metaverse, from mobile devices to VR headsets, advanced haptics, and smart glasses. Smartphones are perceived as highly portable computers connected at all times. Smart devices will become smaller, with accurate sensors, embedded AI technologies, and low-latency access to edge computer systems, absorbing more applications and experiences in the metaverse and building a powerful environment. Oculus Quest went through trial and error with the metaverse technology, which led to the success of Oculus Quest 2 while playing a big role in the development of diverse smart glasses. Furthermore, biometric data based on various wearables and biosensors will have a vital role in helping us enjoy the metaverse.

G. Infrastructure

Infrastructure is technologies that enable devices, connect devices to networks, and provide content. These include 5G, WIFI6, 6G cloud, 7-1.4 nano semiconductors, MEMS, GPU, materials, etc. 5G significantly improves bandwidth while reducing network contention and latency. 6G will take speeds to another level.

<Table 2-1> shows the 7 core elements of the metaverse for the three US companies actively pursuing the metaverse, i.e. Apple, Microsoft, and Meta. Apple is expanding into the fast-growing service area based on its hardware business and is centralized technically. Microsoft is a software and services company, and many developers leveraging its software ecosystem are at the core of its business model. The firm's hardware business, including the HoloLens and Xbox, is also growing recently. Meta's revenue mostly comes from advertisements. The company changed its name from Facebook to Meta, actively revealing its vision for the Metaverse.

<Table 2-1> Major Companies' Metaverse by Core Element

Core elements	Apple	Microsoft	Meta
Experience	Apple Original TV	Games, including MS Flight Simulator, Minecraft, Halo, The Elder Scrolls, etc.	Multi-dimensional SNS services, including Supernatural VR, Facebook, Instagram, Venue, etc.
Discovery	App store, Apple Music, Apple TV, Apple search ad	Windows store, Xbox, MS Ad Networks	Oculus Store, advertisements using various SNS, etc.
Creator	Xcode (required for building MacOS and iOS applications and many developer frameworks)	Development tools, including Visual Studio, VScode, etc.	Horizon World (VR development platform providing tools with no-code, low- code, etc.)
Spatial Computing	Metal (Apple's 3D graphic API), Apple Maps (important resource of augmented reality), ARKit (Augmented reality application	Direct X (Provides 3D graphic API) MS' spatial recognition AI	Meta is currently studying multi-layer UI, holograms, gesture AI, etc.

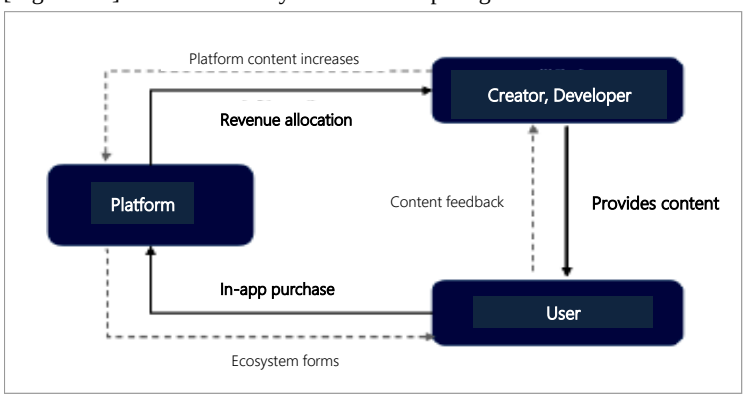
	development framework)		
Decentralized	Hostile to decentralization. Apple's interoperability is limited to interoperability among Apple products, not with the Internet or other providers	DDID (Decentralized Digital Identity): A trust framework that uses blockchain to protect personal information on the web	Developed the virtual currency DM and the virtual wallet Novi to put the DM in. Suggested the possibility of NFT related developments.
Human Interface	Manufactures iPhone, computers, wearables like Apple Watch, Apple TV	Expanding to various human interfaces using HoloLens, Xbox Game tech, etc.	Smart glasses like the VR device Oculus series and AR device Ray-Ban series
Infrastructure	M1 (Expanding performance and power efficiency using SoC (System on Chip) where various elements like memory, processor, graphics, etc. are integrated in a single chip)	Mainly composed of SW infrastructure. Uses Azure Cloud, Xbox, etc. to build the infrastructure.	Implied that the company will build various infrastructure centered on Oculus.

Source: Jon Radoff's materials. Reconstructed by the author.

2. Ecosystem of Participating Entities[12]

The ecosystem in terms of metaverse utilization consists of platforms, creators, and users. The platform supports creators and users, the participating entities in the metaverse, to build an ecosystem.

[Figure 2-4] Metaverse Ecosystem of Participating Entities



Source: KB Securities,「Metaverse, A Digital Parallel World」, Mar. 8, 2021

A. Platform

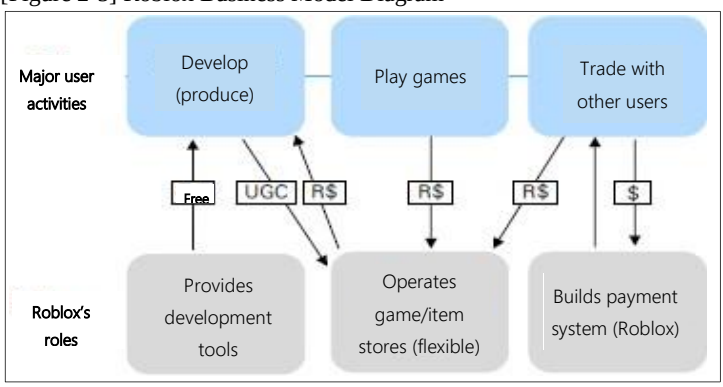
The platform builds and manages the metaverse ecosystem. Its roles are to 1) Provide an environment for creators to create content, 2) Manage users and encourage their active participation, and 3) Create a market for smooth interaction between creators and users.

[12] Written in reference to KB securities material (Mar. 8, 2021)

Currently, platforms act as content creator themselves (platform = content creator) or build a separate creator environment to foster creators (platform ≠ content creator). The former is easy to manage content but limits diversity and participation. In the latter case, creators use their own studios (Roblox Studios, Zepeto Studios) to produce content and sometimes use external engines (Unity, Unreal Engine).

Platforms permit the creators' content that passed censorship after production to prevent political issues and crimes. They also manage users while giving freedom to increase voluntary participation. For instance, Roblox has a separate 'For parent' screen on the website specifying avatar costume censorship and chat filters since more than 80% of its users are teenagers. It increases the degree of freedom for users to build an ecosystem under control, which is a core factor in forming a user-oriented metaverse. Besides simple game elements, it also increases non-game elements for users to interact with each other and increase participation. It holds events like concerts and film festivals for the users can communicate in various ways.

[Figure 2-5] Roblox Business Model Diagram



UGC=User Generated Content.
Source: Yuanta Securities Research Center (Oct. 12, 2021).

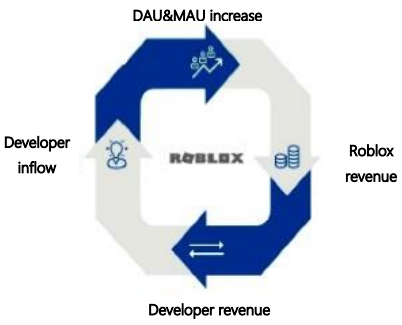
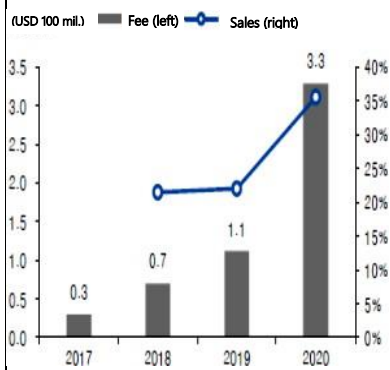
Platforms further establish a monetary payment and compensation system between creators and users. They encourage creators to produce content that meets user demand by building a system that goes beyond simple pleasure and leads to monetary compensation. The metaverse ecosystem created in-app goods (Roblox's Robux, Fortnite's V-buck) that function like money distributed through in-app purchases. Goods can also be converted into money, and users' payment is sent to the creator through the platform.

B. Creator

Creators provide content motivating users to participate in the metaverse ecosystem. The role of creators is expanding as content is produced within the platform in various forms, e.g.

avatar costumes, maps, games, etc. Game companies acted as creators themselves in the past. Recently, however, users participate as creators and sell their content directly on the platform. Economies of scale can be expected as it is possible to induce various users as content increases with the growing number of creators. Creators can generate revenue by developing and selling their content. Content is sold to users as goods within the platform, which can be exchanged and become the creator's profit. Since more people must use the content for increased revenue, creators produce content tailored to users. The more the content, the more the platform advancement and the number of users.

[Figure 2-6] Roblox Business Structure and Payments to Creators

Roblox Business Structure	Payments to game developers
	

Source: Yuanta Securities Research Center (Oct. 12, 2021).

Roblox has an incentive-based economic system that rewards content creators for their contribution to platform growth. This develops into a virtuous cycle growth structure where content providers and users can increase in a balanced way, and more creators can come in as much as the users create games, increasing sales.[13]

C. User

Users, who are at the center of the metaverse ecosystem, develop the ecosystem through high participation and form another community inside the ecosystem. They make monetary payments through in-app purchases or subscriptions, and the purchase and subscription level results in content or platform feedback. It is possible to check which platform and content users are interested in, serving as the basis for platforms and creators to develop.

Users also form a community by communicating with each other within the metaverse. Communities form around users' interests on the platform, contributing to increased users

[13] Yuanta Securities Report (Oct. 12, 2021).

and retention. Users developing bonds through content like celebrities, games, and performances create a culture together.

Section 2 Metaverse-related Technologies

As the definition of the metaverse is diverse and wide, related technologies and industries are also diverse. Accordingly, this section will explain the technologies commonly used in the metaverse, largely classifying into XR (extended reality) and its three constituent of infrastructure, hardware, and software.

1. Extended Reality

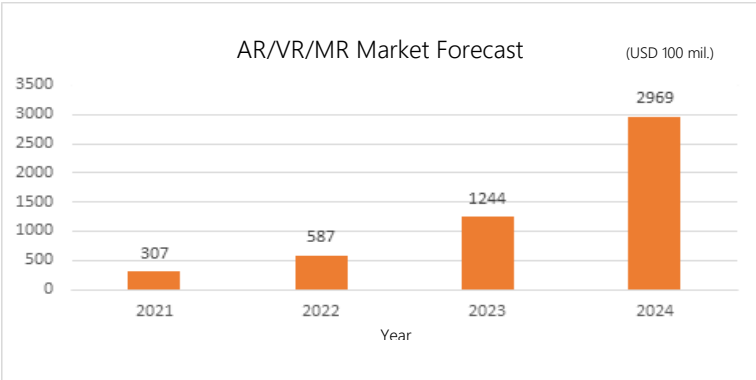
XR is a concept encompassing VR (virtual reality), AR (augmented reality), and MR (mixed reality), and expresses the underlying technology of the metaverse that crosses reality and virtual. VR has the advantage of interacting beyond physical limits in a virtual world disconnected from the real world, whereas AR shows additional digital information in the reality projected on smart devices. MR is a mixture of the two, enabling interaction like a virtual world in the reality projected on smart devices. Let's say you went to a showroom to buy a new car. In VR, you go to a virtual showroom to see and experience realistically reconstructed polygons of the car instead of going to a showroom in person. In AR, you go to a showroom and look at a new car wearing AR glasses, which will help you understand the new car by displaying information on each part of the car. MR shows how the different colors will look or how the interior will change when adding various options 'realistically' beside the simple information.

As the XR market encompasses the three markets based on the new technologies above, the market size and growth rate are expected to be drastic. In [Figure 2-7], a global market research firm Mordor Intelligence predicted that the VR·AR·MR market will grow from about US$ 30.7 billion in 2021 to US$ 296.9 billion by 2024. It forecasted that the characteristics of each XR area will develop rapidly through linkages with all industries.

Among the VR, AR, and MR composing XR technology, the most active area is VR, with relatively few technical limitations. The Oculus Quest series from Meta (former Facebook), which will be covered later, facilitated the VR device market by offering exceptional price discounts. The releases of content using various 3D engines and SDKs are expanding the overall size of the VR market.[14] AR devices for diverse use seem to be limited as described above. However, it is possible to have high expectations for AR devices since their connection with MR will be smoother, while VR devices are restricted to enjoying VR content and platforms. In fact, Microsoft's HMD can perform various MR functions.[15]

[14] Ryu, Han-seok (2020)
[15] Lee, Seung-hwan (2021)

[Figure 2-7] XR(AR · VR · MR) Market Forecast



Source: BCG; Mordor Intelligence (2021).

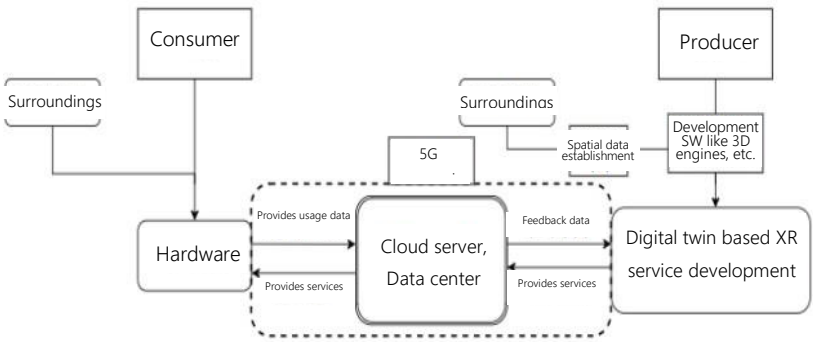
VR technology itself has been introduced decades ago, and AR has long been known to the public since Pokemon Go started service. While MR is the latest technology, it does not seem so new as it is a convergence of VR and AR technologies. What sets it apart from others is wirelessness, connectivity, and interoperability. Existing XR devices, especially VR devices, 1) are connected to external equipment like PCs by wire with external location, and motion sensing devices operated as auxiliary devices, 2) mostly had content enjoyed alone without any interaction with others 3) provided content specific to a specific platform or device not possible to be enjoyed on other platforms or devices. The development of XR technology and the maturation of related markets started to resolve the above issues, laying a technical foundation for metaverse content.

Technological changes of particular significance are as follows. First, the development of APs mounted on XR devices enabled XR content computing independently (STAND-ALONE) instead of relying on external devices. Advanced sensors decreased the dependence on external location/motion sensing devices and effectively lowered the cost of content while reducing reliance on the Internet. The development of Wi-Fi technology, along with 5G communication and cloud technology, built an environment reducing the latency of large amounts of data like VR content, i.e. decreasing the so-called 'lag' even when multiple people enjoy it together. Such an environment effectively lowered the risks in developing and consuming Metaverse XR content. It also became possible to develop content using programming languages and architectures that work identically in various operating systems (OS). Moreover, comprehensive development through convergence became the mainstream, unlike in the past when data, networks, AI, and XR advanced individually, working as the driving force behind the high interoperability of services introduced today.[16]

[16] Lee, Seung-hwan (2021).

[Figure 2-8] conceptually presents the technical distribution process of Metaverse's XR services. The observations that the boundary between consumers and producers will become vague in the metaverse ecosystem will be covered later. Consumers enjoy metaverse content delivered through the cloud using mobile devices/wearables that recognize their biometric data and surrounding space and objects or external devices assisting these devices. Service use data is sent back to producers through the service structure provided in the form of feedback data with minimum disclosure of personal information. Producers can improve their services based on this feedback data. Meanwhile, producers build spatial data using various devices and artificial intelligence to create digital twins for the XR services they want to provide using 3D engines and various SW development tools. Then, digital twins are used to deliver the 'first service' for consumers to the users' devices through 5G communication and the cloud, and the consumers finally use this service. The consumers' feedback data are sent back again to the producer, creating a virtuous cycle of the producer further upgrading the services based on the feedback.

[Figure 2-8] XR Distribution Process



Source: Arranged by the author.

2. Infrastructure

A. 5G Communication/Network

One of the characteristics of the metaverse is that it must have a virtual platform where VR and AR content providing grasping experiences, or immersive content, can be actively distributed and interact with users in various ways. Therefore, the metaverse environment inevitably needs the ability to transmit huge volumes of high-capacity data, thus a high-level mobile communication network. The mobile communication network technology, starting with 1G in 1984, entered the 5th generation era with the opening of the 5G service in 2019. It can reach a transmission speed of up to 20 Gbps, 20 times faster than the maximum speed of 4G.

As 5G aims to facilitate convergence services like IoT, immersive content, and smart cities, its scope differs from 4G, which has targeted simple high-speed wireless Internet services and large-capacity multimedia. [17] The domestic convergence service market, including immersive content and smart cities, remained in the fostering stage until recently, unlike overseas markets that have started to marketization on a full scale. [18] However, the special circumstances due to COVID-19 increased interest in the use of the metaverse and accelerated the development of digital twin-based smart cities and immersive content using VR and AR, significantly improving the domestic utilization of 5G communication.

The 5G telecommunications service market is estimated to be worth about $41.48 billion as of 2020 on a global basis and is expected to exceed $600 billion by 2028. [19] 5G service providers include AT&T and Verizon in the US, China Mobile in China, and Deutsche Telekom in Germany. In Korea, three major mobile telecommunication companies, SK Telecom, KT, and LG U+, have been providing 5G telecommunication services since 2019.

B. Cloud (SaaS, Paas, IaaS)

Cloud service is "a method of accessing and using IT resources like hardware and software without directly building or operating them." [20] While there are several service models in the cloud service industry (hereafter the cloud industry), the top three services are leading the industry: SaaS (Software as a Service), Paas (Platform as a Service), and IaaS (Infrastructure as a Service).

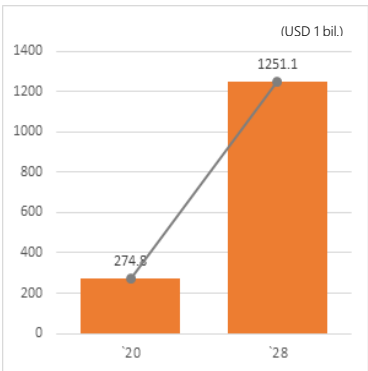
SaaS, the service with the highest share among the three, is a cloud service providing software that users can use right away online e.g. Google Docs, Naver documents, and MS Office. PaaS provides an environment for users to create their own applications. Amazon, SAP, MS Azure, Google App Engine, and Oracle are PaaS providers. IaaS rents infrastructure like servers. Similar to PaaS, IaaS providers include Amazon, Microsoft Azure, IBM, and Oracle. In Korea, there are companies such as Douzone Bizon and Naver.

Along with 5G communication, the cloud industry is one of the most important infrastructure industries for the metaverse. The future capabilities of the metaverse depend largely on how much the cloud industry maximizes user convenience. If 5G communication can be likened to a highway, the cloud is a type of transportation that runs on it. You are selecting whether you want to enjoy a service someone already made, like a highway bus (SaaS), go to various roads and draw a map driving yourself, or, if necessary, assemble some parts of the car yourself and drive (PaaS, IaaS). As in [Figure 2-9], the entire global cloud market encompassing SaaS, PaaS, and IaaS is estimated at around $274.8 billion as of 2020.

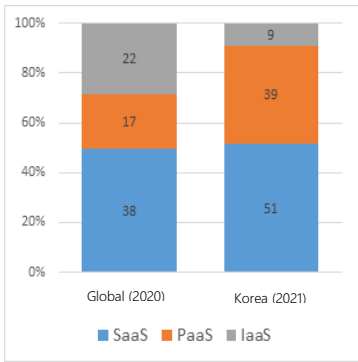
[17] Yoon, Hyeon-yeong (2019).
[18] Lee, Jun-pyo (2020).
[19] Grand View Research(2021).
[20] Ministry of Science and ICT (2021).

It is expected to grow to approximately $1.2511 trillion by 2028.[21] Gartner predicted the global public cloud market to be approximately $270 billion in 2020, $332.3 billion in 2021, and $397.5 billion in 2022. Gartner also discovered that SaaS accounted for $102.8 billion (38%), PaaS $46.3 billion (17%), and IaaS $59.2 billion (22%) in the entire cloud market as of 2020. In Korea, the demand was initially focused on IaaS, followed by SaaS and PaaS, with a market share of 51.4% (SaaS), 39.4% (IaaS), and 9.1% (PaaS) as of 2021.[22]

[Figure 2-9] SaaS·PaaS·IaaS Cloud Market



<Global Market Forecast>
Source: IDC (2021).



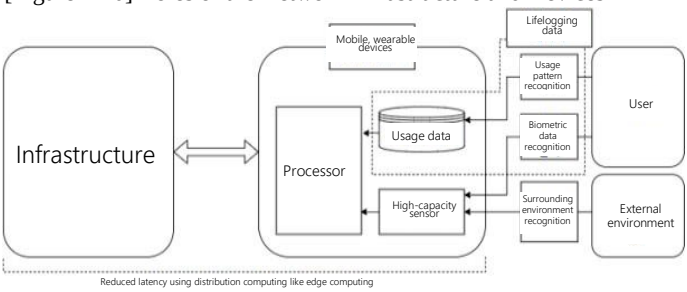
<Global and Domestic Cloud Market Structure>
Source: Gartner (2021); IDC (2021).

3. Hardware

[Figure 2-10] shows the importance of network infrastructure and devices in metaverse implementation. Service users consume metaverse content by communicating with infrastructures like the 5G network and the cloud using mobile and wearable devices. Lifelogging data such as user service usage patterns and biometric data pile up in mobile and wearable devices and are sent to the metaverse infrastructure via processors. Spatial data like biometric data and the surrounding environment undergo a primary cleaning process as personal information blurring and are transmitted to the processor via high-performance sensors e.g. smart sensors. It is then finally communicated to the infrastructure through distributed computing like edge computing, making the overall data flow efficient. Approaching from the infrastructure and hardware aspects cannot explain what technologies implement the metaverse contents we use. However, all the software technologies and infrastructure, hardware, and software technologies to be introduced next will help to make it relatively easy to explain the metaverse XR technology.

[21] Grand View Research (2021).
[22] IDC (2021).

[Figure 2-10] Roles of the Network Infrastructure and Devices



Source: Arranged by the author

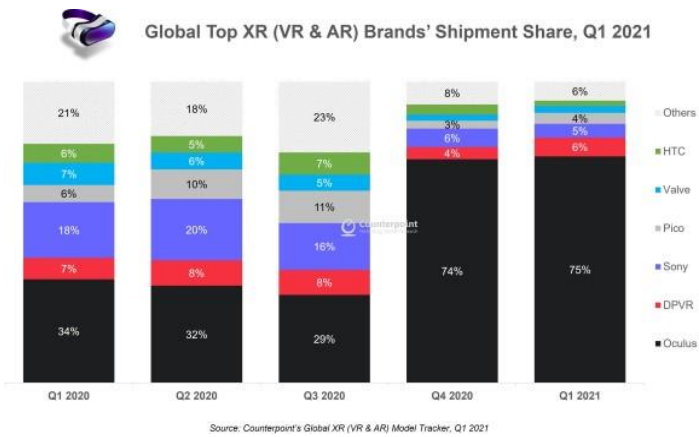
A. Mobile, Wearable Devices (Smartphones and VR Devices)

Smartphones are not simply a channel that provides various metaverse services to users. They also collect user information through various processors, including smart and AI sensors, to discuss later, which use such information and function as important means of supplying individualized data back to service providers.

If smartphones are the source for collecting data, VR·AR devices provide immersive experiences. The VR device market is currently growing fast. It is difficult to identify the market size separately, but IT market research and consulting agency IDC predicts that sales will reach 8 million units in 2021 and 29 million in 2025. Although VR devices are at the center of the metaverse trend, the high prices make accessibility low. After Meta sold its Oculus Quest 2 launched in 4Q 2020 at a significantly discounted price, it quickly took up more than 70% of the market share. This seems to be a strategy to make up for losses from discounts through content to be released later, similar to what existing console game companies did. Meta CEO Mark Zuckerberg himself mentioned the Metaverse at a conference, proclaiming that the Oculus Quest series will serve as the foundation.[23]

[23] Meta (2021).

[Figure 2-12] Status of XR Device Logistics



Source: Counterpoint Research (2021).

AR devices are developing rapidly like VR devices, but most are for industrial purposes. MS HMD released B2B products for the industry, manufacturing, and defense sectors, and small and medium-sized startup companies in Taiwan and Canada launched demand-specialized AR devices by industry. A report by NIPA (National IT Industry Promotion Agency) also found that there is no universal AR device in the market, analyzing that the major issues with the devices include little convenience and low definition (Lee Hyuk-jun, 2020). However, rapid technological development presents a potential for significant growth in the AR device market. As in the VR/AR device sales forecast mentioned earlier, IDC predicts that sales of less than 1 million units in 2021 will reach 21 million in 2025.

B. High-performance Sensors and Semiconductors

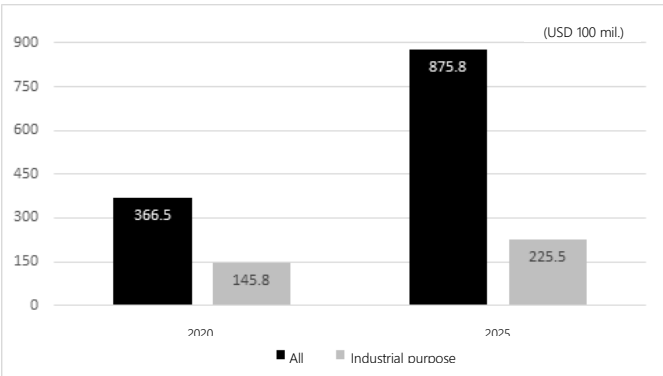
Major devices above consist largely of processors, sensors, and displays. Compared to general devices, mobile and wearable devices have numerous sensors that help users receive various services. Among them, smart sensors[24] are considered vital for mobile and wearable devices, with a market size of $36.6 billion in 2020 and expected to grow to $88 billion by 2025. The importance of smart sensors in the metaverse is more substantial than we think. [25] They are critical for recognizing and transmitting various biometric data and the surrounding environment, playing a key role in realizing 'immersive experiences,' a core feature of the metaverse (R&D Special Zone Promotion Foundation, 2021). In other words, smart sensors are one of the crucial elements for collecting biometric-based life-logging data

[24] Sensors that recognize temperature, humidity, touch, pressure, motion, space, location, light, etc., also known as intelligent sensors.
[25] MarketandMarkets, "Smart Sensor Marke,t" 2020.

for providing immersive content and mirror-world data required for building digital twins.

Demand for diverse system semiconductors and processors and high-performance sensors using system semiconductors is expected to increase as XR devices used in the metaverse ecosystem must detect and collect many types of biometric data. A system semiconductor refers to a non-memory semiconductor with only specific functions, unlike the commonly known memory semiconductor specialized in storing information. System semiconductors are essential for parts and components used in various industries, e.g. CPU, GPU, ASIC (application-specific integrated circuit), etc., and crucial for metaverse devices and content requiring countless specific calculations. There are about 8,000 types of system semiconductors as much as their specialized performance. Thus, the companies involved in these semiconductors include comprehensive semiconductor companies, fabless manufacturers specializing in design, and consignment companies producing semiconductors designed by fabless companies.[26]

[Figure 2-13] Smart Sensor Market



Source: MarketandMarket (2020).

C. Improved Microprocessors and GPU

In the existing Internet, most data were in the form of texts. Considering the popularity of non-graphic games like Text Adventure, the CPU could handle most calculations. However, the advancement of mobile communication networks and computer devices has increased consumers' demand for higher-definition video and high-end games. This led to a surge in demand for graphic data simple but requires a large amount of data. CPUs could no longer process calculations alone. Processors specialized in graphics calculations became necessary, bringing about GPUs (Graphic Processing Units).

Originally specialized in the game industry, the GPU market started holding the central

[26] Lee, Mi-hye (2021).

place of the IT market with high performance in deep learning-based AI requiring an overwhelming number of simple calculations or multiple parallel computing. In addition, it became critical for implementing the metaverse that requires high-definition video and photo data. The significance of GPU will grow as almost all cloud-computing environments must handle more and more high-definition photo and video data.

4. Software

The two characteristics unique to the metaverse would be 'immersive virtual space' and my 'avatar' in that space. The following are the software technologies that can implement the above two characteristics: the 3D engine for building virtual spaces and avatars and the digital twin, critical for enhancing immersion in virtual spaces.

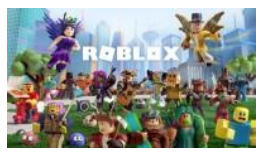
A. 3D Engine

Along with the three metaverse trends, there are 3D engines that stand out: Unity Engine from Unity Technology and Unreal Engine from Epic Games. These engines can implement XR (extended reality) [27] as well as simple online content, making it possible to build digital twins, [28] a vital element in metaverse services, provide various simulation functions, and enable collaborations with various industries.

[Figure 2-14] Representative 3D Engine of the Metaverse

Unity Engine of Unity Technologies

Unreal Engine of Epic Games



Roblox

While companies like Unity or Unreal Engine provide high-performance engines capable of implementing high-level XR, there are ones like Roblox that provide engines specialized for developing simple games. Roblox's value chain aside, it made a business model of developing a game engine easy for even children to use and earn profit by immediately disclosing it to people. Roblox is now one of the most notable companies.

[27] A concept that oversees augmented reality (AR), virtual reality (VR), and mixed reality (MR).
[28] A technology concept advocated by GE (General Electric) to predict various results in advance by creating twins identical to real space and objects in electronic devices like computers and simulating various situations that may occur in reality. (GE, 2016).

B. Digital Twin

The bottom line of the digital twin is the 'real-like digitization' of assets in the real world. This requires a wide range of spatial data. Here, the spatial data is not simply the map of a building but the act of recognizing and digitizing various objects in the building.

[Figure 2-15] Point Cloud

(Before) (After)

Source: Maxst

In the past, people took pictures and videos in various definitions, marked dots one by one, and directly calculated the distance from the camera to build a virtual space. However, it is now possible to turn a wider space into a virtual space faster as various deep learning-based visual recognition can be combined with parts like semiconductors and sensors or hardware like mobile and wearable devices, belonging to final goods. Maxst, a Korean company, combined its AR VPS (Visual Positioning Service) with a 3D point cloud to make 3D space recognition of AI learning easier, facilitating the utilization of XR space maps to expand the usage.

The XR market is not yet as large as other industries in the metaverse market as the concept was embodied by GE just back in 2016. By contrast, the digital twin-related market was about $ 3.1 billion in 2020 and is expected to grow more than ten times (about $ 48 billion) by 2026.

Chapter 3

Cases of Metaverse Applications

Section 1 Manufacturing

The manufacturing sector uses the metaverse mainly to reduce costs. XR technologies facilitate the manufacturing and design process automation, and simulation in the virtual space of the metaverse saves time and cost. The metaverse also increases productivity and efficiency by enabling work sharing among employees and collaboration with experts around the world. However, it is worth remembering that the utilization of the metaverse in the manufacturing field is not a new phenomenon and the industry has already been using augmented reality (AR) and virtual reality (VR) on site. This is because the metaverse is a more comprehensive concept encompassing AR and VR.

1. Efficient Production Procedure

In December 2020, the government announced a plan to innovate the production process by building and operating virtual factories in the three major manufacturing sectors, including chemicals, automobiles, and shipbuilding and marine, using XR, a technology that implements the metaverse as part of its Digital New Deal policy. The project will utilize digital twin technology to create a factory identical to reality in the metaverse space and then apply XR to the entire process of design, operation, and management.[29]

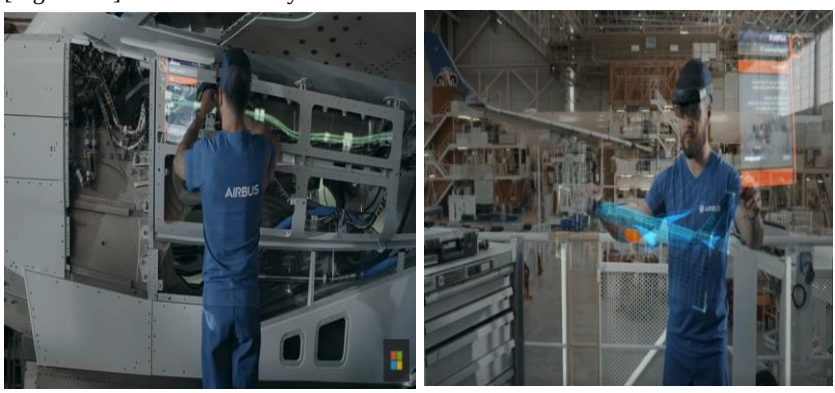
A smart factory refers to a future-oriented factory with better production efficiency by applying various IT technologies to the production process. The AR metaverse is realizing smart factories by changing the manufacturing site and factory environment. At AR-applied workplaces, workers can easily find various parts information, inventory status, overall assembly drawing, factory operation status, lead time, [30] etc. required for work. Such information minimizes work process errors and prevents operational disruptions, helping to

[29] Financial News,「Automobiles and ships to be designed and validated in 'Virtual Factories'」, Jun. 30, 2021 (https://www. fnnews.com/news/202106301832474823, Accessed on Nov. 30, 2021).
[30] Time required from the start of production to completion of a product.

improve product quality and lead time.[31]

Europe's largest aircraft manufacturer Airbus is providing an augmented reality system called MiRA, which shares information on aircraft under construction in 3D with engineers. MiRA uses AR and IoT to increase the efficiency of aircraft inspection. Airbus recently introduced HoloLens 2, AR glasses from Microsoft (MS), to check detailed information on parts and components in the manufacturing process, assembly drawings, inventories, and the assembly status of passenger planes. It reduced the inspection period for some parts of the A380 model from 3 weeks to 3 days.[32]

[Figure 3-1] AR Utilization by Airbus



Source: Microsoft HoloLens, YouTube (https://www.youtube.com/watch?v=lxjC4Z05qh8, Accessed on Dec. 1, 2021).

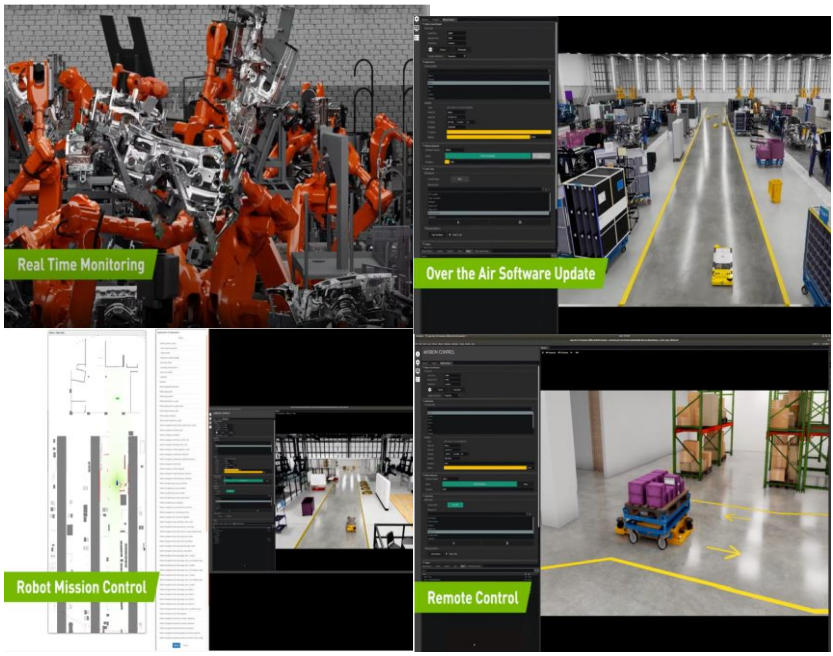
Germany's leading automobile maker BMW applied AR apps to tablet PCs to replace various parts inspection in its Munich plant in 2019. The AR app, co-developed with the Fraunhofer Institute for Computer Graphics, performs 50 inspections in the actual assembly process, including whether various manufactured parts are in the proper dimensions and whether the system assembled is in the correct location. The AR app accelerated the inspection process and notably reduced the defect rate. [33] After attempting to innovate the manufacturing process, BMW went further and announced its 'Virtual Factory Project' to use Omniverse, a 3D collaborative graphics and simulation platform from NVIDIA), to virtualize the entire factory in April 2021.

[31] Dong-A Business Review,「Jump into Metaverse」, Issue 2, No. 317, March 2021, p.36.

[32] Lee, Si-han,「The Age of the Metaverse」, Dasan Books, 2021.

[33] Joongang-Ilbo (Apr. 19, 2019),「Virtual reality from 'Iron Man' appears in BMW plants」(https://www.joongang.co.kr/article/23445814#home, Accessed on Dec. 2, 2021).

[Figure 3-2] BMW Virtual Plants using Omniverse



Source: NVIDIA YouTube (https://www.youtube.com/watch?v=6-DaWgg4zF8, Accessed on Dec. 2, 2021).

The idea is to drive the manufacturing system in real-time on the Omniverse platform to change the location, movement route, and line of parts in the production plant to verify the defects and production efficiency. Specifically, the company aims to virtually build various production models considering all the elements in the plant, including workers, robots, buildings, and assembly parts, and measure the resulting productivity. Even for building new plants or manufacturing new car models, problems can be solved by correcting the errors that may occur in the real world while inspecting the production process in the virtual plant first. Running virtual simulations based on the actual design will enable prior calculation of the production time for unit products, the time from raw material input to product completion, and the time from order receipt to consumer delivery. It will also be possible to check in advance the process with the highest productivity by placing the workforce and robots in the production process. Simulating all elements of the entire plant through the Omniverse is expected to reduce planning time and improve flexibility and precision, increasing the efficiency by 30%.[34]

[34] Lee, Seung-hwan, Metaverse Begins, Goodmorning Media, 2021.

2. Job Training

Metaverse is useful for training workers on the details required and various skills necessary for the manufacturing process. XR-based vocational training enables employees to acquire manufacturing or skilled technologies in difficult situations such as working environments dangerous for beginners, unavailable direct factory visits, or expensive materials.

BMW adopted AR in its 18-month-long production engineer training. While experienced instructors conducted one-on-one individual training with engineers, it became possible for one instructor to train three engineers at the same time after introducing AR. It drastically brought down the training costs. The evaluation of learning achievements and the satisfaction survey of participants showed that the results were the same as the existing method. Jaguar Land Rover partnered with German auto parts company Bosch and used AR for repair training without disassembling the dashboard.[35] Mercedes-Benz uses virtual assembly. When a worker holds a part in his hand and assembles it, the sensor recognizes the motion and the avatar on the screen moves in the same way. You can virtually experience the assembly process of completing a car by moving an avatar without actually assembling the parts one by one to build one. This way, job training can be provided most effectively by reflecting the opinions of skilled assembly technicians going through virtual experiences.[36]

Korea opened the 'Manufacturing AI Metaverse Factory Experience Hall' in November 2021 based on the need to introduce an on-site experience training system where users can experience the process of collecting, storing, and analyzing manufacturing data with AI. The Manufacturing AI Metaverse Factory is a virtual smart factory implementing AI specialized in manufacturing in the metaverse. You can experience the same level of processes occurring on-site and run manufacturing AI analysis simulations. It is now possible to experience the process realistically without interfering with real-world operations and analyze the cause of the problem and apply it to the actual process. AR·VR·XR equipment allows users to access, communicate and collaborate simultaneously from anywhere in the world.[37]

[35] Dong-A Business Review (2021).
[36] Lee, Seung-hwan (2021).
[37] KAIST Times, 「'Manufacturing AI Metaverse Factory Experience Hall opens」(https://times.kaist.ac.kr/news/articleView.html?idxno=20589, Accessed on Dec. 2, 2021).

[Figure 3-3] Manufacturing AI Metaverse Factory Experience Hall

Source: DigiForet YouTube (https://www.youtube.com/watch?v=xAXEWV2Jj2o, Accessed on Dec. 2, 2021).

3. Remote Collaboration

The metaverse virtual reality system is widely applied to designing. Entering the physical values and characteristics of the object to be tested and conducting the experiment in a virtual space similar to reality make it possible to overcome the limitations of time and space and greatly reduce development time and cost. In the case of collaborations involving multiple people, the participants can view and immediately modify the designed results, and come up with collaborative design by working with experts scattered around the world.[38]

Hyundai Motor Group holds metaverse design meetings. Designers working locally around the world will go to work in the ‘Hyundai Motor VR Development Space’ created in a virtual space with their avatars and hold new car design meetings. They explain ideas to each other, change the shapes of various parts like headlamps with hand movements, and select colors and materials to see if they match. They resize and reposition parts and even place the designed car in the desired time and space. The innovative design of the hydrogen-only heavy-duty truck concept car 'Neptune,' unveiled in October 2019, was created in this virtual reality. Hyundai Motor expects to reduce the new car development period by about 20% and annual development costs by 15% by introducing a 'virtual development process' throughout the entire R&D process.[39]

[38] Lee, Si-han (2021).
[39] Lee, Seung-hwan (2021).

[Figure 3-4] Hyundai Motor Group's Virtual Development Process

Source: Hyundai Motor Group YouTube (https://www.youtube.com/watch?v=Wdawq_s1Zzg, Accessed on Dec. 2, 2021)

Section 2 Marketing Activities

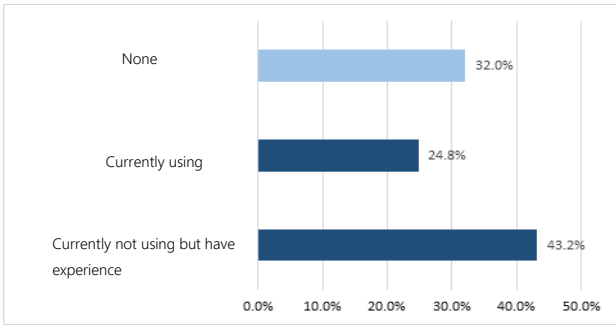
The metaverse was mainly used in games in the past. It is rapidly expanding the metaverse into areas closely related to real life e.g. shopping, performance, finance, and education. Such growth is from the combination of various factors, including the development of metaverse building technologies e.g. infrastructure (5G, cloud), hardware (wearable devices), software (3D engine, VR/AR.XR); increased demand for non-face-to-face interaction after COVID-19; and companies targeting the MZ generation familiar with online.

Generation Z, born from the mid-to-late 1990s to the early 2000s, is also known as "digital natives," those naturally exposed to the digital environment from a young age and are familiar with digital. The results of the survey on the 'Metaverse usage status and awareness' targeting teenagers showed that 68.0% of respondents said they are currently using or have used the Metaverse platform (Figure 3-5).[40]

[40] 'Metaverse usage status and awareness' survey conducted by Smart School Uniform on a total of 710 teenagers.

[Figure 3-5] Experience using metaverse applications or programs

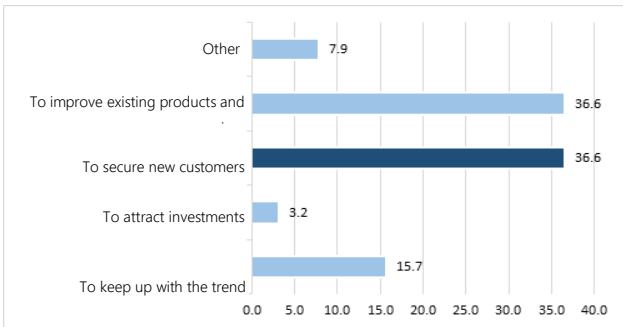
(Unit: %)



Source: Smart School Uniform. The Korea Economic Daily (2021), 「Mastering Metaverse with One Book 2022」Recited.

[Figure 3-6] Reason for using the Metaverse

(Unit: %)



Source: KDI (2021).

In an interview with the media, an official from the retail industry said, "Generation Z established itself as a key consumer group. It is a 'digital native generation' more used to expressing their opinions using messengers and social media than face-to-face communication. You can market new products and see the response by increasing the number of consumers in the metaverse. It is useful for companies with long histories to introduce their brands to the new generation." [41]

In a survey conducted for this study (KDI, 2021), 36.6% of the responding companies answered that their purpose is to secure a new customer base when asked the reason for using the Metaverse in their business (Figure 3-6).

[41] IT Chosun, 「Starbucks, Lotte and CU, why the distribution industry is hooked on the metaverse」, Oct. 31, 2021. (http://it.chosun.com/site/data/html_dir/2021/10/29/2021102901561.html).

1. Marketing using the Metaverse Platform

From luxury goods like Gucci to brands popular with Generation Z, including Nike, MLB, and Converse, enter the metaverse platform like Zepeto to promote their brands and advertise to teenagers, the future consumers. They sell fashion items for avatars and hold promotional events. Gucci made a 'Gucci Villa' in Zepeto to resemble its headquarters in Florence, Italy. Customers can see the products, try them on their avatars and buy them. French fashion company LVMH also launched Dior's makeup collection on Zepeto.[42]

There are promotions to release items for avatars, but K-Pop artists stage events like fan signing events, and fan meetings in Zepeto to communicate with fans and promote new songs in the metaverse.

Companies try to promote their brands and products by opening virtual stores in Zepeto. BGF Retail opened the 'CU Zepeto Hangang Park Branch' store on the Hangang Park map, Seoul's Hangang Park realized in Naver Zepeto. According to reports, around 2,900 CU-related posts have been posted and marked more than 2.7 million views on the social network service feed within Zepeto, selling about 220,000 CU avatar fashion items after the CU Zepeto Hangang Park branch opened in August 2021. The CU video booth and photo booth events held in early September attracted 720,000 participants within a week.[43] Thanks to these marketing effects, CU opened its second store on Zepeto's Classroom 2 map, with the highest number of users. CU plans to increase brand familiarity with teenagers, Zepeto's main users, and global users.[44]

Lotte World also opened a Lotte World map, motivated by Lotte World Magic Island, on Zepeto as part of its online marketing. Visitors can take pictures at the landmark Magic Castle and virtually experience representative attractions like Atlantis and Gyro Drop. Reports said that the cumulative number of visitors exceeded 3 million within three weeks of opening the map, and the ratio of overseas users reached 90% of the visitors.[45] <Table 3-1> shows the major marketing events held in Zepeto.

The financial sector is also targeting future consumers by opening branches in the virtual world and organizing metaverse response TF teams. KB Finance opened 'KB Finance Town' in Gather consisting of a finance/biz center, an at-home center, and a play area. Customers can visit the KB Financial Town Finance/Biz Center in Gather using their avatars and receive

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[42] News 1, 「"Get on the metaverse." Companies lined up at Zepeto... 'Monetizing' even the regular users」, Jul. 27, 2021 (https://www.news1.kr/articles/?4377988).

[43] Maeil Business Newspaper, 「720,000 visitors in just a week … to cook ramen they can't even eat」, Sep. 2021 (https://www.mk.co.kr/news/business/view/2021/09/885013/).

[44] Seoul Economy Daily, 「Metaverse convenient store hits big … CU opens second branch on Zepeto」, Sep.14, 2021 (https://www. sedaily.com/NewsVIew/22RGME2TDQ).

[45] Sports Donga, 「Accumulated number of visits to Lotte World's map on Zepeto exceeds 3 million 」, Nov. 10, 2021 (https://sports.donga.com/economy/article/all/20211110/110167046/2).

counseling on financial products like deposits and loans at the virtual window. Job seekers interested in KB Bank can get recruitment information from current employees at the PR and Recruitment Center.[46]

Shinhan Card's strategy is to sign a business agreement with Naver Zepeto to build a Shinhan Card virtual space in Zepeto to facilitate communication with Generation Z. The company plans to put in customers' Zepeto avatars in its card design, and release Z-generation customized metaverse cards with functions tailored to the card usage patterns of teenagers.[47]

Shinhan Bank is pushing ahead with building its own metaverse platform and opening the first branch in the metaverse instead of collaborating with the existing metaverse platform. It is also planning to issue stablecoin linked to real money with lower price volatility than other digital coins under the judgment that a digital asset connecting the metaverse world and reality is necessary.[48]

<Table 3-1> Major Marketing Events held on Zepeto

Date	Category	Event	Details
Sep. 2020	Entertainment/New album release	Released Ice Cream MV	Released avatar MV of a new song by Black Pink & Selena Gomez
Sep. 2020	Entertainment/Fan signing event	Blackpink fan signing event	Blackpink fan signing event
Sep. 2020	Fashion	Cristian Louboutin 21SS collection	Released new Cristian Louboutin products & Loubi World map
Feb. 2021	Government institution PR	Imagine Your Korea	Korea Tourism Organization PR event
Feb. 2021	Entertainment/Fan meeting	ITZY fan meeting	Girl group ITZY fan meeting
Feb. 2021	Fashion	Gucci	Released Gucci 21 SS virtual collection and Gucci Villa map
May 2021	Distribution	Business agreement with BGF Retail	Opened CU Zepeto Hangang Park branch
Jul. 2021	Fashion	Dior collaboration	Launched Dior brand avatar items
Aug. 2021	New car marketing	Hyundai Motor Group new car test-drive experience	Sonata N test drive
Aug. 2021	Fashion	Ralph Lauren collaboration event	Launched Zepeto Ralph Lauren World map and started selling virtual-only items
Oct. 2021	Theme Park	Lotte World	Opened the Lotte World map, motivated by Lotte World Magic Island
(TBD)	F&B	Starbucks	To open virtual store on Zepeto

[46] News 1, "[Experience] 'Game-like bank'...A visit to KB Kookmin Bank's Metaverse virtual branch", August 3, 2021 (https://www.news1.kr/articles/?4390265)

[47] Shinhan Card press release, "Shinhan Card joins hands with global metaverse Zepeto for the first time in the financial sector!" (https://www.shinhancard.com/pconts/company/html/promotion/press/1211218_3999.html).

[48] The Herald Economy, "[Exclusive] Shinhan Bank reviews plan to hold virtual assets… Required for its own metaverse", 2021. 11. 8 (http://news.heraldcorp.com/view.php?ud=20211108000141).

Source: Hyundai Motor Securities, Company Report, NAVER (Oct. 25, 2021); Sports Donga,「Accumulated number of visits to Lotte World's map on Zepeto exceeds 3 million」, Nov. 10, 2021; Seoul Economy Daily,「Starbucks goes to Zepeto」, Aug. 26, 2021

Overseas, Nike opened Nike Land on the representative metaverse platform Roblox. In Nike Land, inspired by the Nike headquarters building and facilities, users can play or create their own games. Users can also decorate their avatars with Nike products in the Nike showroom with products currently on sale and even those released in the past.[49]

[Figure 3-7] Nike Land in Roblox

Source: Roblox website (https://www.roblox.com/games/7462526249/NIKELAND#!/about).

Nike announced its ultimate goal of realizing world-class sports events at Nike Land. Nike will be able to utilize users' reactions to new products collected at Nike Land for developing new Nike products in the future.[50]

2. Marketing with Virtual Humans

US market research firm Business Insider Intelligence predicted that the cost of marketing by companies using influencers will increase from $8 billion in 2019 to $15 billion in 2022. Bloomberg estimated that a large portion of this amount will gradually go to virtual influencers in an article citing this figure. [51] Cases of marketing using virtual world influencers are actually on the rise.

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[49] Chosun Biz,「Nike on board the Metaverse: To open Nike Land in virtual space」, Nov. 19, 2021 (https://biz.chosun.com/international/international_general/2021/11/19/SOUATLRVPVDDPN3WNJTCSQ5YGY/)

[50] Maeil Business Newspaper,「Nike opens virtual space Nike Land with Roblox」, Nov. 19, 2021 (https://www.mk.co.kr/news/world/view/2021/11/1084435/)

[51] Bloomberg Businessweek, "Virtual Influencers Make Real Money While Covid Locks Down Human Stars," 2020. 10. 30(https://www.bloomberg.com/news/features/2020-10-29/lil-miquela-lol- s-seraphine-virtual-influencers-make-more-real-money-than-ever).

Virtual humans today are integrations of visual effects (VFX) technologies, 3D modeling/rendering, computing processors, and AI technologies. Better performing 3D modeling and rendering tools, the development of visual effects (VFX) technology like motion capture, and the improved CPUs and GPUs create facial expressions and gestures of virtual humans, far more natural as real people compared to the 1990s cyber singer Adam.[52] Creators develop virtual humans by combining hundreds of faces that the MZ generation likes. The personalities of virtual humans reflect the culture of Generation Z, who speaks out without being self-conscious.[53]

The world's most famous virtual influencer is Lil Miquela, developed by a US startup Brud, and has over 3.1 million Instagram followers as of November 2021. She is actively working in various fields: modeling for luxury brands like Chanel and releasing songs. She also signed a contract with CAA (Creative Artists Agency) which pop star Lady Gaga belongs. Reports say that the unit price of advertising posts on her Instagram account is $8,500, and Brud earns 13 billion won in revenue alone through Lil Miquela.[54]

<Table 3-2> Virtual Human Industry Ecosystem

Industry	Business	Major firms
Visual effects (VFX)	Creating virtual human content	Brud, Cydus Studio X, Giant Step, Onmind
3D modeling and rendering	Providing virtual content creation tools	Autodesk, Pixologic, Blender, Epic Games, Unity
CPU	Virtual content data processing	Ndvia, Intel

Source: The Korea Economic Daily (2021),「Mastering Metaverse with One Book 2022」, 2021.

[Figure 3-8] Virtual Influencers Lil Miquela and Rozy

Source: Official Instagram accounts of Lil Miquela (@lilmiquela) and Rozy (@rozy.gram).

[52] The Korea Economic Daily (2021),「Mastering Metaverse with One Book 2022」

[53] Sisa Journal,「Virtual influencers in the real world 」, Aug. 8, 2021 (https://www.sisajournal.com/news/articleView.html?idxno=221677).

[54] Hangyore,「The virtual beyond the real is not impossible」, Oct. 5, 2021. (https://www.hani.co.kr/arti/economy/economy_general/1013869.html)

<Table 3-3> Instagram Followers and Major Activities of Virtual Influencers

Name	Country	Number of followers (Unit: 100,000 people)	Major activities
Lil Miquela	US	310.9	• Modeled for luxury brands Chanel, Prada, Burberry's, etc. • Released the album 'Not Mine'
Knox Frost	US	70.0	• World Health Organization COVID-19 PR Ambassador
Imma	Japan	35.4	• Furniture brand IKEA Harajuku store model
Shudu	UK	21.8	• French fashion brand Balmain fall collection model
Oh Rozy	Korea	10.8	• Modeled for Shinhan Life, Martin Golf, etc.

Source: Official Instagram accounts of Lil Miquela (@lilmiquela), Knox Frost (@knoxfrost), Imma (@imma.gram), Shudu (@shu.gram), Rozy (@rozy.gram). The Korea Economic Daily (2021), 「Mastering Metaverse with One Book 2022」. Maeil Economy Daily, 「 The age of virtual humans...Model Rozy becomes a blue chip in the advertising industry with revenues exceeding 1 billion won」, Oct. 18, 2021. Reconstructed.

The most famous virtual influencer in Korea is Rozy, known to the public for Shinhan Life ads. Sidus Studio X created Rozy using 3D synthesis technology by collecting face shapes preferred by the MZ generation. She has more than 100,000 Instagram followers (as of November 2021) and earned more than 1 billion won in annual revenue in 2021.[55]

Some companies have developed their own virtual influencers to promote their products and businesses. LG Electronics created its virtual human Reah Kim and had her participate in the CES online conference, the world's largest consumer electronics fair. Lotte Home Shopping plans to expand its metaverse business by making its virtual model Lucy into a virtual show host.[56]

Virtual influencers advanced to be indistinguishable from humans and can be used for marketing without time and space constraints as all scenes can be created with CG. They do not get sick or grow old like people and have very small risk of ads stopped due to personal controversies as in many celebrity cases.[57]

Although virtual influencers have appearances difficult to distinguish from real people, there are limits to their use. The present level remains only at transmitting pictures or videos of virtual humans made by creators to limited platforms, meaning that real-time two-way communication is impossible. Real-time communication requires implementation with 'real-time rendering' technology as in game engines. The industry is working on to make it possible and expects that virtual humans based on real-time rendering will start appearing from 2022.[58]

[55] Chosun Biz, 「 Virtual humans earning 13 billion won a year... 'Virtual influencer' marketing getting popular」, Oct. 7, 2021. (https://biz.chosun.com/industry/company/2021/07/10/3ILD66VV7FGJLPMTM226 7SKAPE/).

[56] KBS, 「A rising celebrity? 'Virtual humans' solidifying their presence」, Sep. 5, 2021 (https://news.kbs.co.kr/news/view.do?ncd=5272413).

[57] Maeil Economy Daily, "A crazy presence earning 14 billion won a year… 'Sweeps' luxury brand Chanel Louis Vuitton models", Jul. 17, 2021 (https://www.mk.co.kr/news/it/view/2021/07/688436/).

[58] Korea Economic Daily, 「Rozy and Lucy made it..."Virtual humans to host live commerce soon"」, Nov. 22, 2021.

Section 3 Business and Education

After working from home became widely adopted due to the COVID-19 outbreak, the metaverse platform has been an alternative to complement the disadvantages of face-to-face work and maximize the advantages. Communication, collaboration, and education are occurring in virtual space on the Metaverse platform. Mainly used platforms in Korea include Zepeto, ifland, and Gather.town.

<Table 3-4> Metaverse Platforms

Classification	Service	Status
NaverZ	Zepeto	· 200 million subscribers, various performances, and events · Training for new employees
NC Soft	Universe	· K-Pop entertainment app launched in 134 countries
SK Telecom	ifland	· Metaverse school entrance ceremonies, virtual space remote conference, etc.
Cyworld	Platform to be released	· New metaverse platform to be released · Preparing cryptocurrency CLINK
Nintendo	Animal Crossing	· Utilized the avatar of the US president for election campaigns and Hong Kong pro-democracy protests
lox	Roblox	· 100 million users per month creating space with avatars and trading with game money
Gather	Gather.town	· An online platform supporting users to meet each other for communication and collaboration in virtual space
Microsoft	Mesh	· MR-based remote collaboration metaverse platform
Facebook	Horizon	· Possible to communicate with friends by accessing SNS Horizon using Facebook VR device
Spatial	Developed AR collaboration platform	· US startup developing an AR-based collaboration platform. Enables access to the website to participate in meetings.
Decentraland		· Virtual reality platform based on Ethereum blockchain. Possible to sell, do business and construct buildings on virtual lands.
The Sandbox		· Argentinian blockchain game developer. A community-oriented platform that can generate revenue through experience with games that use NFT to create one's own Voxel.

Source: Choi, Jae-yong et al. (Sep. 2021),「This is the Metaverse」.

1. Virtual Offices

The 'metaverse office' market is attracting attention with the metaverse emerging as an alternative to supplement the disadvantages of non-face-to-face work and maximize the advantages.

Spatial is a system that allows you to create a virtual space and have avatars that look similar to you to work there. You can share actual document files used in work with

22 (https://www.hankyung.com/it/article/2021112244001).

coworkers and talk about work while showing your computer screen. It also provides tools for brainstorming, collaborative design, product reviews, and presentations. It is possible to hold meetings in Spatial as it is a virtual space. Facebook Korea held a press conference under the topic, 'The era of true hyper-connectivity, the beginning of the metaverse and future offices.'

[Figure 3-9] VR Business Tool Spatial

Source: Facebook Korea

The controller recognizes the user's hand movements, makes natural gestures, and can even move the mouth when talking. Spatial is used not only in meetings but also for workshops, hospitals, theaters, and university classes.[59]

The Seoul Facilities Corporation was the first public company to introduce Gather.town Office. It piloted one department at the time of introduction. Now all employees are working in a virtual office. Gather.town is a metaverse platform that imitates the office structure as it is, implementing it in a virtual space. There are personal desks, conference rooms, and rest areas prepared just like a real office in the virtual space. Avatars tailored to personal tastes enter this space and work. Workers at home and office of the Planning and Coordination Bureau, General Affairs Office, and Parking Facility Operation Office of the Seoul Facilities Corporation gather to work here.[60]

Seoul Facilities Corporation saved total 460 million won in meeting expenses, printing expenses, training expenses, etc. after it introduced this virtual office. The saved budget was invested in improving the remote work system where complaints were received, upgrading

[59] Ajou Economics (Jun. 17, 2021), "Will there be a future where we work in the metaverse and rest in reality?".
[60] Korea Economic Daily (Jun. 28, 2021), "We work at the 'Metaverse Office,' no different from the real one" (https://www.han kyung.com/life/article/2021062859201).

the network communication environment to reinforce the business system.[61]

[Figure 3-10] Seoul Facilities Corporation Gather.town Office

Source: Korea Economic Daily (Jun. 28, 2021), "We work at the 'Metaverse Office,' no different from the real one"

Virtual offices can implement the offline environment as it is, whether it is a company lobby, a conference room, a meeting room, or a cafeteria. It reduces the sense of distance from the virtual world and the burden of having to stare at others on the computer screens as in remote conference platforms. The employees of the real estate platform Jikbang have been working in a metaverse virtual office that was modeled after an offline office in Seocho-gu from July 1 this year. Jikbang chose to eliminate the physical headquarters office and permanently work from home, going to work only in the metaverse.

2. New Employee Hiring and Training

Naver used Zepeto for the 2021 new employee introductory process, Code Day. 191 new employees from Naver's development, design, planning, and management support departments participated, communicating via 'Band', carrying out missions through video conferences through 'Naver Works', getting together online using 'Smart Order/Naver Pay' and having teatime with 'Naver Gift.' New employees who started working from home from the first day of work visited the company in 3D and took 'avatar photos' with their peers.

Seven-Eleven staged interviews for hiring new employees in 2021 2H on the Metaverse platform Gather.town. Applicants passing the document screening enter the 'Seven Town,' an interview venue on Gather.town, and avatars to enter the interview room and conduct

[61] HR insight. Aug. 2021, "Seoul Facilities Corporation, the first public company to go to work in a virtual office" (https://www. hrinsight.co.kr/view/view.asp?in_cate=109&bi_pidx=32710).

video interviews in their turns. Those waiting for an interview could collect necessary information by looking around the company introduction video screening room, job introduction interviews, recruitment schedule guide, and recruitment Q&A provided in Seven Town.

Seven Eleven actively uses the Metaverse platform for introductory training for new employees and leadership courses for executives as well. Last month, it also held the "Seven Cup e-Sports Competition," a non-face-to-face online sports competition for executives and employees. Kim Il-yeon, head of the HR innovation team at 7-Eleven said, "We plan to expand the scope of the Metaverse throughout the recruitment process, including interviews, recruitment briefings, training for new employees, and education and on-the-job training."[62]

[Figure 3-11] Naver's New Employee Training

Source: NaverZ.

LG Electronics and LG Innotek also held recruitment briefings on the Metaverse. LG Electronics created the 'LG Electronics Meta Campus' within the metaverse platform VirBELA in September 2021 and held a recruitment briefing session. You can use digital avatars to gather in the auditorium to hear about the business and technology of each business division and ask questions with the 'raise hand' function. You can experience mock interviews similar to real ones in employment consulting provided in the interview room.

In May this year, LG Innotek had about 400 college students and about 20 HR managers and field workers meet as avatars at Gather.town to introduce the company, talk with senior employees, consult by job type, and have one-on-one meetings with HR managers. Participants chatted with each other in a space realizing the company's in-house café. Online recruitment fairs alone have limitations in communication. However, the metaverse have merits of being a communication method familiar to the MZ generation and enabling

[62] JoongAng Ilbo, "A virtual space is the interview venue?… The era of 'avatar interviews' begins 」, Oct. 7, 2021. (https://www.joongang.co.kr/article/25013100#home).

interactive communication that combines the advantages of both online and offline.[63]

[Figure 3-12] 'LG Electronics' Meta Campus' space implemented to hold the 'Hi! LG' recruitment briefing
Source: LG Electronics, Joonang-Ilbo (Nov. 7, 2021), Recited.

3. Building Customized Platforms

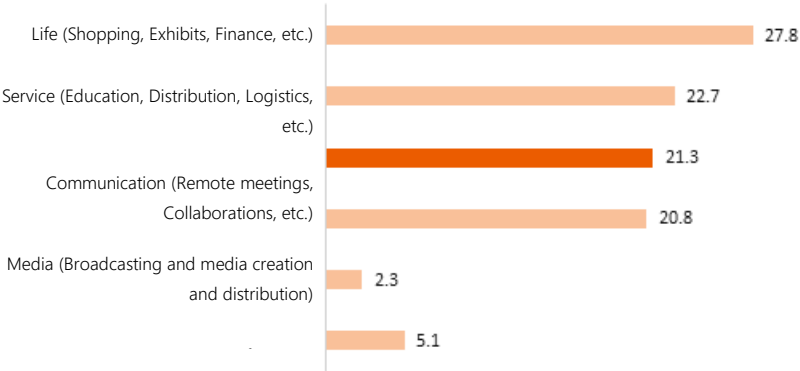
Communication using the metaverse, such as remote meetings and collaboration, is and will be widely used in various fields. In the KDI (2021) survey, 21.3% of the respondents pointed out that communication (remote meetings, collaboration, etc.) is likely to be most active metaverse utilization in the future.

Hancom and LG U+ are planning to build a new metaverse platform to secure distinctive competitiveness in the metaverse market. Hancom will start beta service of Hancom Town, a metaverse-based meeting space service, in December this year. Employees can go to work in a virtual office using avatars set to their personal preferences and have voice conversations and video conferences with coworkers in Hancom Town. Companies or individuals can hold virtual seminars or advertisements for specific customers. Hancom Town and Hancom Office will be linked to support sharing or editing documents in various formats, including Hangul, Word, Excel, and PPT, and provide various document contents like proposals and thesis by associating with NFT (Non-Fungible Token). It also plans to enable trading of items for decorating avatars or configuring spaces. Taking the launch of Hancom Town as a momentum, Hancom will introduce new services it is promoting to expand the B2C market, while increasing synergy by linking the metaverse and document content based NFTs.[64]

[63] JoongAng Ilbo (Oct. 7, 2021)

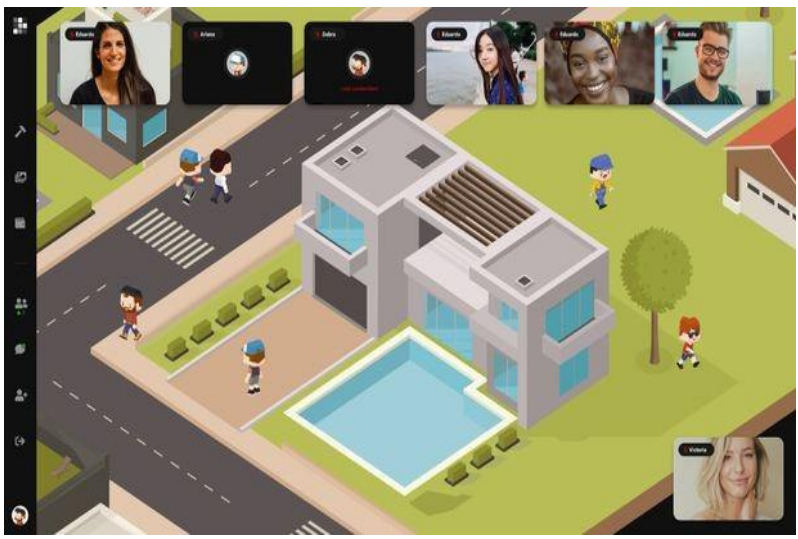
[64] Chosun Biz, 「Hancom to start beta service of its metaverse meeting space Hancom Town in December」, Nov. 15, 2021 (https://biz.chosun.com/it-science/ict/2021/11/15/5VBFHRVWMFDQPLBDBOPROSELCU/).

[Figure 3-13] Areas likely to have the most active metaverse utilization in the future



Source: KDI,「Survey on the Metaverse industry status and its prospects」, 2021.

[Figure 3-14] Expected image of Hancom Town



Source: Chosun Biz,「Hancom to start beta service of its metaverse meeting space Hancom Town in December」, Nov. 15, 2021 (https://biz. chosun.com/it-science/ict/2021/11/15/5VBFHRVWMFDQPLBDBOPROSELCU/).

Meanwhile, LG U+ is preparing to collaborate with Unity Korea, which has the world's largest real-time 3D (RT3D) content development platform, to build a virtual office matching the company's characteristics. LG U+ plans to use Unity to create a virtual office service slated for release next year, and to continue cooperation in various metaverse

technology fields.[65]

Section 4 Culture, Arts and Leisure

1. Turning Crisis into Opportunity: Performances in Virtual Space

Offline cultural and art content viewing moved online and started to provide grasping content in the virtual world as it became impossible to meet face-to-face due to the outbreak of COVID-19 after 2020, and with the help of technological advancements.

The case in point of applying the metaverse to performances was a virtual performance within the popular game of Epic Games, Fortnite. In April 2020, famous American rapper Travis Scott performed at Party Royale, a space for enjoying without fighting in Fortnite, a battle royal genre game. According to Epic Games, more than 27.7 million players attended the 10-minute, five-show performance. [66] Pop star Ariana Grande collaborated with Fortnite to hold a performance in August 2021.

[Figure 3-15] Online Concerts in 2020

2020 Travis Scott Concert

2020 SM Super Junior Beyond Live

Source: Fortnite Official Twitter(https://twitter.com/FortniteGame/status/1254817584676929537), SM Entertainment.

[65] Korea Economic Daily, 「LG Uplus joins forces with Unity for the metaverse…To create a virtual office」, Nov. 10, 2021. (https://www.hankyung.com/it/article/202111100081i).

[66] Forbes, "A Staggering Number of People Saw Fortnite's Travis Scott 'Astronomical' Event", 2020. 4. 28(https://www.forbes.com/sites/davidthier/2020/04/28/a-staggering-number-of-people-saw- fortnites-travis-scott-astronomical-event/?sh=34bb1be67b41)

<Table 3-5> Major online concert ticket revenue estimates in 2020

Artist/Agency	Performance date	Number of accesses	Lowest ticket price (KRW)	Number of accesses x Lowest ticket price (Unit: KRW 100 mil.)
Super M/SM	April 26	75,000	33,000	24.8
NCT127/ SM	May 17	104,000	33,000	34.3
Super Junior/SM	May 31	123,000	33,000	40.6
BTS/Big Hit	June 14	756,000	29,000	219.2
BTS/Big Hit	October 11~12	993,000	49,500	491.5

Source: Korea Economic Daily, "NCT127 'Ontact Concert' marks 4 billion in sales… 'Flood' of K-Pop paid online performances," May 18, 2020; JoongAng Ilbo, "Bang Bang Con with revenue of 22 billion, Super Junior Show armed with AR… Evolution of online K-Pop performances," Jun. 15, 2020; JoongAng Ilbo, "990,000 people in 191 countries saw BTS concert... 49.1 billion in ticket revenues alone,", Oct. 12, 2020. Reconstructed.

All previously scheduled performances were canceled after the COVID-19 outbreak and agencies held online concerts to overcome the crisis. SM Entertainment was the first to move and collaborated with Naver V Live in 2020 to hold the world's first online-only paid concert Beyond Live series. The latest technologies, including AR, VR, and XR, were used in the performance to convey the realism of a live performance. Large agencies such as Hybe and JYP followed SM and succeeded holding online concerts. can <Table 3-5> shows the Ticket revenue estimates for major online concerts in 2020.

Offline performances have resumed after the implementation of With Corona in countries with high vaccination rates and domestic artists are also announcing offline performance schedules for 2021 4Q (see <Table 3-6>). The demand is also increasing explosively as there were no offline concerts for about two years. For example, the highest ticket price for BTS' 'Permission to Dance Stage' concert scheduled at SoFi Stadium in Los Angeles, USA was $450 but soared to $18,323 on ticket resale sites.[67]

<Table 3-6> Major Artists' Offline Concert Schedule in 2021 4Q

Artist	BTS	NCT 127	Twice
Concert name	BTS Permission to Dance on Stage	NCT 127 Second Tour Neo City: Seoul – The Link	TWICE 4TH WORLD TOUR 'III'
Date	Nov. 27~28, Dec. 1~2	Dec. 17~19	Dec. 24~26
Venue	LA SoFi Stadium	Gocheok Sky Dome	Olympic Park Gymnastics Stadium
Ticket price	$75~450	All seats 132,000 won	All seats 132,000 won

Source: Munhwa Ilbo, "Illegal ticket price soars to 21.65 million won… "BTS US performance fever 'consoles' the global village suffering from COVID-19", Nov. 12, 2021.; Yes24 Ticket (http://ticket.yes24.com/).

Under the circumstances, industry insiders have mixed opinions about the fate of online performances after COVID-19 ends. Some say online performances continue in parallel for

[67] Munhwa Ilbo, "Illegal ticket price soars to 21.65 million won… "BTS US performance fever 'consoles' the global village suffering from COVID-19" Nov. 12, 2021. (http://www.munhwa.com/news/view.html?no=2021111201030203351001).

audiences with geographical and time constraints because they have become accustomed to non-face-to-face contact during the pandemic. By contrast, an official said in an interview with the media that there is no reason to continue online performances if COVID-19 is completely over.[68]

2. Creation, Transaction and Ownership via NFT

After Beeple's NFT work 'Everydays: The First 5,000 Days' sold for $69.3 million, *The New York Times* attributed the NFT craze to the irrational tulip craze that occurred in the Netherlands in February 1637.[69] Artist Biffle himself said in an interview with Fox News talk show 'Fox News Sunday' that NFT prices are in a bubble.[70]

Despite doubts about intangible digital assets and concerns over NFT fever, facilitation of NFT can bring opportunities to creators. First, the creator can specify the royalty for the work when issuing (minting) one's own work as an NFT. Once the royalty is determined, the specified rate goes back to the creator whenever the corresponding work is sold in the secondary market. Second, NFTs enable direct transaction and communication between the original creator and collectors or fans the creations whereas existing works of art or sound sources could be distributed through galleries or record companies (streaming companies) in the traditional distribution system. Blockchain technology and NFTs are empowering creators in general.

A. Concept of 'Non-Fungible Tokens (NFT)'

Products in the virtual world can be easily duplicated and distributed. To solve this problem, Non-Fungible Tokens use blockchain technology to give scarcity to digital products and clarify ownership, enabling them to be traded as products with economic value.

'Non-fungible' means that something cannot be replaced because it is unique like a house or car in the real world. Fungibility is the opposite concept of non-substitutability, meaning each unit of a specific asset can be mutually replaced, and digital currencies such as Bitcoin fall into this category. A 'token' is a specific asset in the form of a digital file stored on a blockchain. Taken together, NFTs are specific assets in the form of digital files on the blockchain with respective uniqueness, making it impossible to substitute for each other.[71]

Digital files themselves can be duplicated but the originals are the only ones endowed with

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[68] Kyunghyang Shinmun, "Concert and Musical meet 'online' … Will it last even after the pandemic is over?" Jul. 17, 2021. (https:// www.khan.co.kr/culture/culture-general/article/202107171111001).

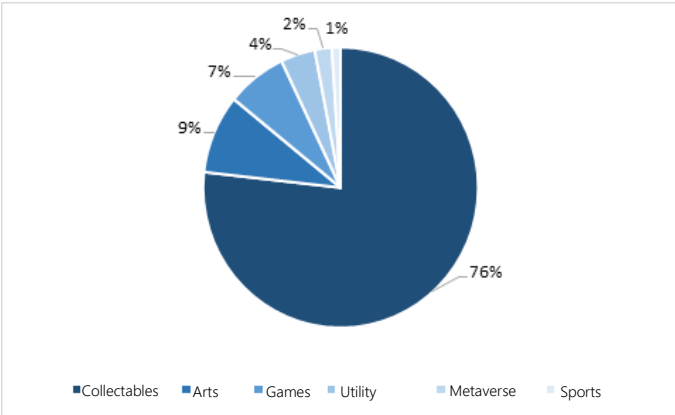
[69] *The New York Times,*「Art's NTF Question: Next Frontier in Trading, or a New Form of Tulip?」, Mar. 30, 2021. (https://www.nytimes.com/2021/03/30/arts/design/nft-bubble.html).

[70] Korea Economic Daily,「Artist Biffle sells NFT works for 78 billion won, "Bubbles in NFT"」, Mar. 22, 2021.

[71] Seong, Sora · Rolf Hoefer · Scott McLaughlin, <NFT Revolution>, The Quest, 2021

a unique recognition value. These features of NFT and the human desire to collect scarce originals led to NFT creations combined with blockchain technology produced and traded in various sectors, including arts, games, sports, and entertainment. This offers significant possibilities for collection-related activities.

[Figure 3-16] NFT Market Share by Sector



Source: NonFungible.com,「NON-FUNGIBLE TOKENS QUARTERLY REPORT Q3-2021」.

According to the 2021 3Q report by NonFungible, an NFT-related analysis company, collectibles account for 76% of the NFT market share, and NFT art accounts for 9% (Figure 3-16). Especially the MZ generation seems to lead the trend. Christie's explained that 90% of the bidders who participated in the Biffle art auction were new registrants, mostly young people[72]

B. Changes in the Game Industry: From Pay to win to Play to earn

With the introduction of blockchain technology into games, the industry is undergoing changes from spending money to win and buying items or 'Pay to win (P2W)' to making money while playing or 'Play to earn (P2E).' Game companies allow users to convert items obtained from games into NFTs and set up NFT markets (exchanges) for trading. Game users can trade game items with in-game coins, and the coins obtained in this way can be cashed on the virtual asset exchange.

[72] Chosun Ilbo,「Craze? Bubble? NFTs are obsessions with ownership」, Apr. 11, 2021. (https://www.chosun.com/economy/science/2021/04/11/GLLLM7RWCBDMXB6ENVZWMSTCI4/).

1) Sky Mavis' Axie Infinity

Axie Infinity from Vietnamese startup Sky Mavis is the most representative P2E game. Game users can obtain coins called Axie Infinity Shards (AXS) by collecting, breeding, and nurturing the NFT character 'Axie,' Pokemon-like characters with different appearances and abilities. You can buy and sell Axies with this coin, and also cash it out on the virtual asset exchange.

Axie Infinity gained great popularity in Southeast Asia, and the number of users surged from about 40,000 in April 2021 to more than 1.7 million. As a result, AXS Coin, only worth around $4 until early July 2021, skyrocketed more than 3000% in 4 months, trading at over $140.[73]

2) Wemade's MIR IV Global

WeMade is representative among domestic companies. In MIR 4 Global, launched in August 2021, you can mine 100,000 Darksteels to exchange for an in-game coin called 'Draco.' After converting Draco into the self-issued cryptocurrency WEMIX coin in WeMade's virtual asset wallet Wemix Wallet, it can be deposited into domestic virtual asset exchanges such as Bithumb and Korbit and sold in Korean won.[74] WeMade CEO revealed his ambition to list WEMIX on the top 50 global exchanges in an interview with the media.[75] WeMade further plans to turn in-game items and characters into NFTs for trading on exchanges. MIR 4 Global is quite popular. It ranked first in role-playing games in countries, including Belgium, the Philippines, UK, Venezuela, Brazil, the Netherlands, Iraq, and Qatar, and the number of concurrent users exceeded 1.3 million.[76] Recently, other game companies like NC Soft, Kakao Games, and Netmarble have also announced plans to enter the NFT business and are taking active steps (see <Table 3-7>).

[73] Maeil Business Newspaper, 「Earn money by playing games…Global P2E fever on the rise」, Oct. 31, 2021. (https://www.mk.co. kr/news/business/view/2021/10/1031324/).

[74] The Korea Economic Daily, 「"Earning money while playing games"...P2E causes blockchain revolution in the game industry」, Nov. 10, 2021. (https:// www.hankyung.com/it/article/202111109708g).

[75] News 1, 「WeMade plans to "list its cryptocurrency 'Wemix' on top 50 global exchanges"」, Nov. 18, 2021. (https://www.news1.kr/articles/?4497115).

[76] IT Chosun, 「"The power of P2E," MIR 4 Global achieving results in Europe」, Nov. 14, 2021. (http://it.chosun.com/site/data/html_dir/2021/11/12/2021111202164.html).

<Table 3-7> NFT Strategies of Major Game/IT Companies

Company	Details
WeMade	· Issued blockchain virtual currency 'Wemix', incorporating in-game economic system · Operates NFT trading platform 'Wemix Auction'
Com2uS·Gamevil	· Signed MOU with 'Terraform Labs', a blockchain infrastructure operator · Plans to issue its own virtual currency C2X (tentative name)
NC Soft	· NFT combined game to be released next year · Finalized technical review for self-issuance of virtual currency
Kakao Games	· CEO's shareholder letter reveals plans for 'development of NFT exchange'
Netmarble	· Established a dedicated organization for research on utilizing NFT technology
Hancom	· Link NFT to Metaverse-based meeting space 'Hancom Town'
CJ Olive Networks	· Proceeding with issuing NFTs for famous artworks recreated by AI

Source: Dong-A Ilbo,「"Earn money while playing games" … The game industry falls into NFT」, Nov. 29, 2021.

3) Concerns about causing Speculative Behavior

The stock market is also excited by the successive announcements of game companies to introduce NFT. WeMade's share price rose to 230,000 won in November from around 30,000 as of August in 2021. NC Soft's 2021 Q3 earnings fell short of market expectations, but share price soared by 29.92% from the previous trading day after it announced plans to introduce NFT games in an earnings release conference call.[77]

However, GRAC (Game Rating and Administration Committee) is currently banning the domestic service of NFT games in Korea for encouraging speculation. WeMade's MIR 4 is provided without the NFT service, unlike the global version. GRAC claims that blockchain games cannot be rated because they violate the provision on the prohibition of speculation in the Game Industry Promotion Act Article 28.[78] The act game companies directly arranging for item monetization is prohibited in the rating of existing games as well.[79]

Several game industry officials and experts expressed their opinion in interviews with the media that the potential of NFT arises if the content, the core of the game, is fun.[80, 81]

C. K-Pop and NFT: Expansion of the Business Model

[77] Maeil Business News,「Stok price skyrocketed at a word from NC Soft...What was it?」, Nov. 13, 2021. (https://www.mk.co.kr/news/stock/view/2021/11/1070167/).

[78]「 Game Industry Promotion Act」Article 28 (2) (s)he shall neither have others gamble or do other speculative acts by making use of game products nor leave them to do such things. Article 28 (3) (s)he shall not promote speculation by offering free gifts, etc. (Source: https://www.law.go.kr/).

[79] Financial News,「P2E·NFT... Blockchain game industry is growing, but Korean regulations are going backwards」, Nov. 14, 2021. (https://www.fnnews.com/news/202111121632317219).

[80] Aju Econom,「The 'NFT' craze blowing in the game industry… half expected, half concerned」, Nov. 17, 2021. (https://www.aju news.com/view/20211116222928449).

[81] Dong-A Ilbo,「"Earn money while playing games" … The game industry falls into NFT」, Nov. 29, 2021. (https://www. donga.com/news/Economy/article/all/20211128/110498608/1).

The existing business model of K-Pop entertainment was somewhat limited to sales of albums, goods, and tickets. Recently, K-Pop agencies are making efforts to expand their business models based on fan community platforms and artist IP-based NFT businesses. The growth potential of K-Pop and NFT collaboration will be high due to the combination of passionate loyal customers and human desire to possess what they like.

Blockchain technology will enable agencies to maximize the added value of the artist's IP by converting the parts that have not been utilized so far into digital assets. The fandoms expected that artist IP-based content and products obtained through fan activities will be digitalized as assets, leading to compensation and a virtuous cycle of the fandom economy.

For example, Hybe posted a 2021 business briefing video on its YouTube channel Hybe Label in November 2021. At the briefing session, Hybe Chairman Bang Si-hyuk formalized the establishment of a new joint venture with Dunamu, the operator of the cryptocurrency exchange Upbit, and the artist IP-based NFT business plan. The plan is to use blockchain technology to turn photo cards, which previously existed only in real life, into NFT digital assets with recognized uniqueness. He also revealed possibilities of enabling collection, exchange, and exhibition in Hybe's fan community platform and providing methods that are more synesthetic by adding moving images, voices, and music beyond a simple photo.[82]

Other large agencies, including SM, JYP, and YG, are planning to enter the NFT business. Prior to Hybe, JYP formalized its entry into the NFT business by signing a business agreement with Dunamu in July 2021. YG's subsidiary YG Plus also announced its entry into the NFT business through the NFT joint venture established by Hybe and Dunamu. SM is known to have an NFT manager in the company and is preparing to issue NFTs using a blockchain platform.[83] SM Executive Producer Lee Soo-man gave a presentation on the on "The Next Level of Entertainment Opened by NFTs and the Prosumer Economy" at the "Breakpoint 2021" conference hosted by the blockchain platform Solana Foundation in November 2021.[84]

[82] YouTube Hybe Label Channel Business Briefing "2021 HYBE BRIEFING WITH THE COMMUNITY" (https://www.youtube.com/watch?v=XBIDpFNrOZA).

[83] Digital Daily, "[Exclusive] SM Entertainment enters the NFT business… possible to use blockchain platform Solana", Nov. 8, 2021. (http://m.ddaily.co.kr/m/m_article/?no=225124).

[84] Seoul Economic Daily, 「SM Executive Producer Lee Soo-man says the Metaverse World will be connected with NFT, Nov. 10, 2021 (https://www.sedaily.com/NewsVIew/22TYP7TBKI).
(https://www.sedaily.com/NewsVIew/22TYP7TBKI).

Chapter 4

Industrial Potential of the Metaverse

Section 1 Introduction

The previous chapter looked into the technical characteristics and specific use cases related to the metaverse. The purpose of this chapter is to integrate these discussions and explore the economic potential of the metaverse on a more general level. After exploring what economic values the metaverse can bring based on economic theories and research on existing technologies, we will find out at what point such a possibility can be realized, and how likely it is for Korea to achieve industrial success in each sector of the metaverse value chain based on the survey outcome.

Various discussions and analyses in relation to the metaverse are mostly limited to explaining the technological possibilities of the metaverse and the most optimistic scenario or the most innovative case presented by this technological change. The representative forecast is that the development of VR/AR will reduce the gap between virtual and reality, and many actual activities will move to virtual space. Studies in this direction provide very useful implications for exploring the maximum potential of new technologies. However, as with any cutting-edge technology, it remains to be seen whether this change will be limited to a few leading companies or will be applied throughout the economy to increase productivity and change people's lives, and which industries and businesses will be affected by it.

This chapter redefines these questions by applying an economic perspective and seeks the best answers available at present. One of the key questions in figuring out the economic potential of the metaverse is whether it will merely replace some of the existing offline economic activities, expand it, or create new value by enabling businesses not possible due to technological constraints. As it is similar to the problem of whether the increase in trade and welfare among countries participating in free trade agreements (FTAs) is merely a result of diverting trade with other non-member countries or is due to new opportunities created by FTAs, the same logic can be applied. If the economic value of the metaverse claimed by individual companies or industries is based on the premise of that much reduction in other fields, the metaverse is nothing more than converting offline or existing online economic

activities.

Another important issue is how far-reaching the metaverse can be. Looking at significant technological changes in the past, new technologies were widely adopted only when they became affordable enough to be used by a large number of companies and the organizational capacity needed to use them was in place. The metaverse is still a very early concept, and there seems to be a lot of time left before entering such a phase. Would there be a metaverse model intuitive and inexpensive enough to be used by many companies in the future? We can measure the economic impact of the metaverse by thinking about this question.

If the metaverse presents a very large economic opportunity, which companies will drive and benefit from this change? Will startups have an advantage since it is a new technology? Or will the established giants take the lead? These questions have significant implications for industry and regulatory policy.

At this point, it is not possible to provide perfect answers to these questions. The definition of the metaverse is neither clear yet nor technologically mature. There also are various opinions about the specific utilization method. However, an analysis using available theories and data is expected to provide meaningful implications in its own way in the absence of minimum empirical evidence and statistics.

Section 2 Metaverse in the Economic Aspect

1. How is the Metaverse different from the Existing Virtual World?

The metaverse is generally defined as the convergence of the real and virtual worlds. It encompasses all aspects of virtual realization of the real world with various technologies or expansion through virtual elements. As stated in the previous chapter, the concept of a virtual world is not new. Virtual reality technology has already been applied in various fields.

Then why is the metaverse attracting attention if it is not new at all? This is because important changes have occurred in both aspects of 'virtual' or 'world'. In other words, VR/AR technologies have advanced to the point of making the boundary between virtual and real ‘seamless,’ enhancing users' experience satisfaction and making the metaverse content attractive and immersive. Many experts emphasize the importance of the latter. What is more important is that interaction between people and various economic activities based on it are possible in the open world, not simply using advanced technology but breaking away from consuming fixed content. As the metaverse is not a virtual world limited to a specific purpose, it can be used to replace or expand reality for various objectives.

In this respect, people's acceptance of new technologies and their ability to persuade others are as important as, or even more important than, technology. Various metaverse platforms like Fortnite, Zepeto, and Gather.town do not necessarily use state-of-the-art graphics. Nevertheless, the avatar fully represents the self in reality and gives a feeling similar to

reality e.g. being able to hear the conversations of people in the near distance better even in virtual space for people to fully interact in the same way as in reality.

COVID-19 has greatly increased the acceptance of the metaverse. One of the biggest shocks of the pandemic is that social distancing and border closures have significantly reduced people's interactions. People searched for the alternative online, and found out that various types of activities such as academic conferences, in-house meetings, small classes, and reading groups are possible as long as interactions in the real world are functionally implemented even if it is not technically complete. The point is that technology is evolving in a way to understand and satisfy people's perceptions and needs, rather than simply implementing cutting-edge technology. Technological developments such as VR/AR will function in making activities in virtual spaces, which have increased due to COVID-19, more immersive and enhancing the quality of experiences.

The major metaverse platforms understand this well, and this give users the freedom to create and interact with new content and elements, rather than binding the entire virtual world to a specific purpose. They understand that activities that arise accidentally in such a process provide new business opportunities.

Interactions in the virtual world basically are extensions of social interactions in the real world. Creating an account representing oneself on Twitter, Instagram, Facebook, etc. while using the information in virtual space as a means of authenticating the real me based on this virtual-reality connection is a case in point. In the recent metaverse, however, the boundary between virtual and reality is relatively weak, and various activities are increasing through avatars with identities unrelated to reality. This has significance of implying the possibility of economic activities based on pure virtual space not connected to reality.

Many companies leading the metaverse trend, such as Roblox and Fortnite, are based on games. This is because they not only have technical capabilities like graphics reproducing grasping reality, but also the competitive edge in providing an immersive environment tailored to the needs of users, having the ability to implement an open world view by utilizing various sub-games, and providing a multiplayer environment based on virtual identity.

What is interesting is that these game companies started with various types of games and built a metaverse based on their own worldview and environment. Rather than a single or a few huge metaverse platforms like YouTube of video and Facebook of social network dominating everything, it is likely that metaverses meeting various needs will compete in the future.

2. Relationship with the Offline Industry

The metaverse shows that various activities considered only possible in real life can be done in virtual space. Travis Scott's concert on Fortnite is a representative example. If so,

will more offline-based industries move to virtual space in the near future, if not right now? Many books and reports predict that metaverse-based activities will become more dominant.

In the end, the metaverse produces economic value by providing people with experiences, but experiences are time consuming. Since time is finite, it is impossible to watch offline and online performances simultaneously. Therefore, if the time spent on performances is fixed, the growth of the metaverse may mean the reduction of the offline-based music industry.

However, recently emerged discussions on the experience economy suggest that the emergence of the metaverse will not necessarily threat offline-based industries. Let's take art museums for example. Since the advent of the Internet, it became possible to easily see masterpieces by searching without necessarily visiting a museum. Nevertheless, the number of visitors to the Louvre or the National Gallery is rather increasing. The museums even provide their collections online with good quality pictures and in-depth explanations. This is because there is always a demand for personalized consumption of goods and services, and online paintings are more of a supplement to promote personalized art consumption than a substitute for it.

To understand this, we should look at the history of industrial development. Modern economic growth has largely been driven by increased productivity in the manufacturing sector. Productivity growth in the manufacturing sector is fundamentally based on the model of efficiently replicating the same product and offering it to a large number of consumers at a low cost. The emergence of factories, large-scale production facilities and assembly lines provided the technological basis. On the other hand, in the case of the service industry, especially the cultural industry, it was impossible to mass-produce or increase productivity in the same way as in the manufacturing industry because a certain amount of input was required for on-site experience. Economist Baumol's cost disease is a compressive expression of this concept. Output in the number of performances cannot increase over time, but the labor cost of performers does increase. The service industry shared these limitations because the time and place of production and consumption must coincide (Heilbrun, 2003).

But technological innovation has increased productivity by enabling even services to be replicated in large numbers. Opera was one of the representative forms in the case of performing arts. Due to the high fixed costs required to hold performances, only cities could hold opera performances, and many consumers not living in cities did not have access. Cost disease exists because demand is constrained. Movies made consumption possible anywhere as they are filed once and recorded in media. Mass consumption opened a way to increase productivity in the cultural industry (Bakker, 2012).

We come up with the following questions here: How were cultural products like operas and musicals affected by the mass-replicable films? Studies on the cultural industry show that the existing performance industry has not completely collapsed with the advent of movies, but low value-added performances difficult to compete with movies have declined.

Accordingly, the performing arts industry has moved toward higher added value, and the demand for watching performances on site has rather increased even if it meant purchasing expensive tickets. Filmization of musicals also has the implication of additionally increasing demand for on-site performances rather than replacing them. This shows that sharing the same experience on site is still difficult to substitute, and consumption of duplicated products leads to demand for more scarce ones.

The music industry also proves that making cultural products accessible to anyone through mass reproduction does not necessarily reduce the demand on site. Digital sound sources replaced physical records and made music consumption easier for more people and resulted in their inflow into the music industry. While the digitalization of the music industry has progressed rapidly, the global music industry's sales from on-site performances exceed the sales of digital music and are almost equal to the total sales of music. Live events lead to demand for adjacent cultural products as in tourism.

The experience in the metaverse may be more immersive and realistic than movies or past online cultural products. However, this will probably attract people who cannot immediately consume limited on-site experiences but want a high-end experience than consuming the same product and rather than completely replacing offline demand. The Louvre Museum in the metaverse is more likely to lead to demand for visits to the actual one. Music activities in the metaverse will further increase the demand for offline concerts.

If an ecosystem based on virtual space and AR/VR is established, and rewards and value storage methods like NFT are facilitated within the ecosystem, it will expand incentives to create content, thereby increasing digital content that has not previously been valued. This may generate new economic values irrelevant to offline on a large scale. It will be easier to understand if you remember that the YouTube ecosystem has created a variety of content and relevant businesses that did not exist in the past.

The case of the art market in Chapter 3 shows that digital art that can be reproduced through NFT is redefined as a finite collectible, and as a result, there is a possibility of a virtuous cycle increasing the supply of digital art. However, it is necessary to keep in mind that offline artworks have fundamental value in the direct experience, that is, the viewing itself, and there are limitations of time and space in the act of viewing. The motivation and asset value of owning works are also based on the finiteness of these experiences. However, digital art does not have these characteristics. Therefore, it is judged that the current NFT art boom is based more on the expectation of an increase in the value of holdings and assets than on the viewing experience. Some experts say that the development of AR/VR will make it possible to create works that cannot be implemented in reality in virtual space, and that the experience itself may become a product. In the near future, however, it is highly likely that the technologies will be used to improve and expand art distribution.

It is also worth noting that creators and companies that have already established a considerable presence offline are exploring the possibilities of the metaverse. This also

suggests that the rise of the metaverse is not a threat to the offline economy, but rather that the original competitiveness of the offline sector is highly likely to lead to success in the metaverse.

The next subsection predicts what form each sector in the metaverse will take based on the data obtained through surveys.

Section 3 Companies' Perception of the Changes in the Metaverse Industry

Section 2 presented an analytical perspective on the metaverse based on existing economic studies. Sections 3 and 4 seek to present empirical evidence available at present based on the survey conducted for this study (KDI, 2021). We look at how companies recognize the key to the metaverse business and diagnose the current level of relevant industries in Korea.

1. Survey Overview[85]

The research team conducted a survey of 216 employees of companies that joined the Metaverse Alliance to collect information on business perceptions and methods of companies. Although the outcome cannot be regarded as representative of the entire related industry as it has not been sampled using statistical techniques, the distribution is relatively even in terms of industry type and company size as shown in <Table 4-1>. Service and IT industries are included the most due to the nature of technology, but manufacturing and public institutions also account for a certain proportion.

The table also shows that the data used cover a variety of companies in terms of metaverse utilization fields and business areas. The field of application used the classification of the Metaverse Alliance. This classification largely divides the industries into manufacturing, service (education, distribution, logistics, etc.), life (shopping, exhibition, finance, etc.), communication (remote meeting, collaboration, etc.), and media (broadcasting, media creation, distribution). <Table 4-1> shows that the metaverse is mainly used to provide various services, but also used evenly in other areas. For the business area, it asks which part of the product or service the company makes falls under content, platform, network, device, or software. The companies surveyed largely appear to make content, platforms, and software, which generally seem to reflect the characteristics of metaverse companies appearing in the media well.

[85] KDI surveyed 216 workers with experience in performing related tasks of companies participating in the metaverse alliance from Nov. 3 to 18, 2021 using a web survey method to understand the current status and prospects of the metaverse industry.

<Table 4-1> Characteristics of Survey Samples

Business type	Observation	Ratio (%)	Size	Observation	Ratio (%)
Manufacturing industry	24	11.1	5 employees or less	9	4.2
Service industry	66	30.6	6~49 employees	83	38.4
IT industry	68	31.5	50~99 employees	24	11.1
Public institutions	32	14.8	100~299 employees	29	13.4
Other	26	12.0	300 employees or more	71	32.9
Metaverse utilizing sector	Observation	Ratio (%)	Business area	Observation	Ratio (%)
Manufacturing	16	7.4	Content	72	33.3
Service	69	31.9	Platform	80	37.0
Life	35	16.2	Network	12	5.6
Communication	32	14.8	Device	11	5.1
Media	37	17.1	Software (VR/AR, etc.)	41	19.0
Other	27	12.5			

Source: KDI (2021).

2. Characteristics of the Metaverse Business

First, let's look at how companies perceive the nature of the metaverse. This deals with the relationship between the metaverse and the existing offline business discussed at the end of the previous section. We aim to understand whether the metaverse is used to conduct additional and parallel activities for sales and marketing of the same company's products and customer base; stage a new strategy to sell the same products targeting new consumers who can only be secured in the metaverse; or run a business based on a product based on virtual space, such as NFT.

<Table 4-2> provides an answer to this question. This table shows how companies perceive the key to the metaverse business as a whole and by business area operated by their companies. About half of the companies in the table seem to be aware of the metaverse as an extended space of existing businesses. The recognition was same in all metaverse business areas except for devices. Currently, there is a strong view that the metaverse is an additional marketing channel to the existing sales method. This also implies that the other half of the companies are taking a more active attitude toward the metaverse. About 25% of companies responded that they are using metaverse to secure a new consumer base, and the remaining 25% for business based on virtual space such as NFT.

<Table 4-2> Companies' Perception of the Metaverse Business

	Content	Platform	Network	Device	S/W	Total
Expand existing business areas into virtual space	50.0	42.5	50.0	18.2	46.3	44.9
Utilize virtual space to secure new consumers	27.8	20.0	8.3	63.6	26.8	25.5
Use of content not existing in reality (platform, NFT, etc.)	19.4	33.8	33.3	9.1	24.4	25.9
Other	2.8	3.8	8.3	9.1	2.4	3.7

Note: The sum of the verticals for each business area adds up to 100%.

If so, are companies seizing economic opportunities from these metaverse businesses and actively setting up metaverse strategies? Respondents were asked why their companies are using Metaverse. <Table 4-3> shows that about 45% of the respondents gave a rather passive reason "to keep up with the latest trends," amounting to around 70% if adding the response "to attract investment." Only about 30% gave positive reasons such as "to secure a new customer base" or "to improve existing products and services."

These results indicate that companies do not have strong confidence in the economic potential of the metaverse yet. Their actions have a significance of jumping on bandwagon of a major technological trend than making strategic moves to achieve corporate goals, such as launching new products and services or securing a customer base.

<Table 4-3> Reasons for using the Metaverse

	Content	Platform	Network	Device	S/W	Total
To keep up with the latest trends	52.9	28.6	40.5	49.4	35.3	44.9
To attract investments	23.5	57.1	24.1	26.6	17.7	25.5
To secure a new customer base	23.5	14.3	35.4	21.5	11.8	25.9
To improve existing products and services	0.0	0.0	0.0	2.5	35.3	3.7

Note: The sum of the verticals for each business area adds up to 100%.

3. Prospect of the Metaverse Industry

Nonetheless, more companies will use the metaverse as part of their corporate strategy as the related technology matures and profitable cases emerge. Perhaps that point is when the metaverse creation tool costs become affordable and can be used by the majority of companies and workplaces. A comparable case is that the main starting point for YouTube's explosive growth was when it became possible to produce, edit, and distribute videos with just a mobile phone. Respondents were asked when they expected that point to be. <Table 4-4> shows the results with most companies expecting 3 to 5 years. If the prediction is correct, the competitiveness of content platforms will be put to the test in earnest then.

<Table 4-4> Estimated timing of generalization of metaverse creation tools

	Content	Platform	Network	Device	S/W	Total
In 1 to 2 years	6.9	20.0	25.0	9.1	12.2	13.9
In 3 to 5 years	79.2	66.3	66.7	54.6	65.9	69.9
In 6 to 10 years	12.5	12.5	8.3	27.3	22.0	14.8
Difficult in 10 years	1.4	1.3	0.0	9.1	0.0	1.4

Note: The sum of the verticals for each business area adds up to 100%.

<Table 4-5> Prediction of the Content Industry

Metaverse will be led by the following industry:	Content		Other industries	
	After 3 years	After 5 years	After 3 years	After 5 years
Few global companies	23.6	11.1	18.1	8.3
Global corporates and few domestic companies	26.4	23.6	32.4	24.5
Few domestic companies	8.3	4.2	8.8	4.2
Coexistence of multiple companies	40.3	47.2	38.0	50.5
Difficult to predict/No response	1.4	13.9	2.8	12.5

Note: The sum of the verticals for each business area adds up to 100%.

<Table 4-6> Prediction of the Platform Industry

Metaverse will be led by the following industry:	Platform		Other industries	
	After 3 years	After 5 years	After 3 years	After 5 years
Few global companies	23.8	15.0	30.9	19.1
Global corporates and few domestic companies	57.5	47.5	40.4	42.7
Few domestic companies	6.3	5.0	9.6	7.4
Coexistence of multiple companies	11.3	23.8	15.4	16.9
Difficult to predict/No response	1.3	8.8	3.7	14.0

Note: The sum of the verticals for each business area adds up to 100%.

Then, what will the industry look like after 3-5 years when the popularization of the metaverse will begin in full scale? We asked questions about the expected industry pattern at that time by business area to find this out. First, let's look at the predictions for the content industry in 3 and 5 years. <Table 4-5> is the content sector expected by respondents in the content industry, and in other industries. Overall, there was a strong view that a large number of companies would coexist rather than a small number of global conglomerates dominating everything in the case of the content industry. Also, more diverse companies will be able to coexist after 5 years rather than 3 years. This aspect is common in both inside and outside the content industry.

In the platform industry, the absolute majority of those working in the industry believed that a small number of global and domestic companies would lead the market. Those

working in other industries were more inclined to think that a small number of global companies would have strong dominance. The survey also had a question that allowed respondents to freely specify "the factor of greatest concern in the future industry," and many of those working in platform companies mentioned "global companies monopolizing platforms." Considering that the market dominance of platform companies affects the distribution of profits to content producers and their incentives to produce, policy makers will also need to pay attention to this aspect in advance.

<Table 4-7> Prediction of the Software (VR/AR/XR, etc.) Industry

	Software		Other industries	
	After 3 years	After 5 years	After 3 years	After 5 years
Few global companies	14.6	17.1	24.6	16.0
Global corporates and few domestic companies	34.2	24.4	36.0	27.4
Few domestic companies	14.6	7.3	5.1	4.6
Coexistence of multiple companies	29.3	34.2	29.1	38.3
Difficult to predict/No response	7.3	17.1	5.1	13.7

Note: The sum of the verticals for each business area adds up to 100%.

Next is the software sector. In the case of software, the space for domestic companies is expected to be relatively wide. The rate predicting that a small number of global and domestic companies will lead was the highest and that a large number of companies will be able to compete in the market has increased over time. Note that people in the software sector highly value the influence of global companies compared to other industries. This reaffirms that responding to the dominance of global companies in the parts that play the most fundamental and core role of the metaverse ecosystem, including platforms and software, is a major topic in the metaverse industry.

Section 4 Competitiveness of Korea's Metaverse Industry

This section examines what constitutes the competitiveness of each metaverse industry sector and to what extent Korean companies have reached. This will be of considerable help in deriving policy tasks in the next chapter.

First, let's take a look at what companies think is the core of the metaverse industrial competitiveness. A summary of press releases and existing literature indicates that companies providing metaverse services will be 1) building a huge platform for additional revenue by attracting a large number of users and forming a huge creator-consumer community, 2) focusing more on content to provide customized services for specific needs, or 3) expanding and supplementing the real economy by utilizing augmented reality (AR). There will also be companies whose main business areas are networks, devices and software

that provide the underlying technology for these services.

A common requirement for all metaverse service types is to provide attractive user experiences to consumers. The survey asked about the most necessary elements. As in <Table 4-8>, respondents answered that a high level of immersion and realism in the content was the most important, followed by connectivity with the real world. What is noteworthy is that content and platform companies providing direct services have a relatively high rate of responding that the differentiation of content is important, while those providing base technologies said immersion and realism are more important.

<Table 4-8> Factors required to provide attractive content

(Unit: %)

	Content	Platform	Network	Device	S/W	Total
Immersion and realism	31.9	33.8	33.3	45.5	39.0	34.7
Price competitiveness	2.8	2.5	0.0	18.2	12.2	5.1
Content differentiation	25.0	26.3	8.3	0.0	4.9	19.4
Producer-consumer communication	13.9	10.0	8.3	18.2	9.8	11.6
Real world connectivity	25.0	26.3	50.0	18.2	34.2	28.2
Other/No response	1.4	1.3	0.0	0.0	0.0	0.9

Note: The sum of the verticals for each business area adds up to 100%.

<Table 4-9> Factors required for platform growth

(Unit: %)

	Content	Platform	Network	Device	S/W	Total
Outstanding XR	6.9	8.8	25.0	18.2	22.0	12.0
Content, world view	43.1	40.0	16.7	36.4	24.4	36.6
Interactivity with users	25.0	27.5	16.7	27.3	26.8	25.9
Connectivity with the real world	13.9	13.8	33.3	9.1	24.4	16.7
Creator ecosystem	9.7	8.8	8.3	9.1	2.4	7.9
Other	1.4	1.3	0.0	0.0	0.0	0.9

Note: The sum of the verticals for each business area adds up to 100%.

What about platforms? Respondents in general said that the most important factor was the appeal of content and worldview, followed by interactivity with users. Interestingly, differences in perception are found in the competitive factors of the platform by business area as for content. Content and platform companies put more weight on outstanding content and worldview and interaction with users, while network, device and software companies believed that the excellence of XR technology is more important.

The above results show that there is a huge gap in perspective between companies in charge of metaverse technology and those that use it. This may be largely from the fact that the technological level of the metaverse and the business model utilizing it have not matured.

While companies in the basic technology sector have in mind content and platforms that can be implemented at a more advanced level of technology in the future, content and platform companies focus more on the elements necessary to persuade consumers now.

<Table 4-10> Competitiveness Score by Sector

Sector	Workers in the industry	Workers in other industries
Content	3.47	3.61
Platform	2.85	2.90
Network	3.58	3.50
Device	1.82	2.60
Software (VR/AR/XR, etc.)	3.17	2.91

Note: The sum of the verticals for each business area adds up to 100%.

Then, what is the competitiveness level of Korea's metaverse industry sectors? To identify the level of competitiveness self-diagnosed by companies, the survey had respondents to answer Korea's competitiveness level compared to advanced countries like the US and the UK evaluated on a 5-point scale (1 point: very low, 3 points: average, 5 points: very high). The results in <Table 4-10> show that Korea is relatively competitive in content, network infrastructure, and software areas, but is behind the US and UK in platform and device sectors. It is notable that software workers assessed Korea's competitiveness higher in their field than those in other industries.

Based on the above diagnosis and analysis results, the next chapter draws policy and legal tasks for the metaverse industry to advance.

Chapter 5

Policy Tasks for the Development of the Metaverse Industry

Section 1 Direction for Supporting Policies

So far, we examined the economic potential of the metaverse and the expected changes. This chapter will discuss the kind of policy support necessary and effective for the development of the metaverse ecosystem and industry.

1. Direction of Fostering Policies

First, let's determine where Korea can secure advantages in the metaverse ecosystem and whether support is required. The previous section identified that Korean companies are relatively competitive in the content and network sectors. The platform sector is relatively weak, and opinions were divided between those in the field and those in other fields for the software sector. That said, is it reasonable to focus on the areas good at right now? The views of the companies identified in the survey seem to be a little different.

Column 2 of <Table 5-1> shows the distribution of sectors that respondents pointed out as requiring strategic nurturing. Most respondents answered that content and platform sectors should be fostered. They said that the platform sector must secure competitiveness while content sector should continue use their current strengths. This is probably because the platform features affect the incentives for content creation and production through profit distribution. As explained above, many companies have expressed concerns about the market dominance of global platform companies, but many content companies have made the same point.

Columns 3 to 7 of <Table 5-1> show the distribution of items where respondents thought improvement is required for strengthening competitiveness of each sector. Note that quite a high rate of about 30% of respondents said that not only content and technology but also the ecosystem needs improvements to enhance the content sector. This confirms the importance of platforms in content creation again. It is also noteworthy that respondents pointed out that business model improvement as well as technical prowess are necessary to reinforce

competitiveness in the software sector.

The current government's metaverse related policies in the 'Virtual Convergence Economy Development Plan' can be largely summarized as 1) spreading XR throughout the economy and society, 2) expanding leading XR infrastructure and reorganizing systems, and 3) supporting XR companies to secure global competitiveness. The first is on increasing the overall demand, the second on expanding the technological base centered on devices, data, and networks, and the third is on the support for companies centered on loans, basic technologies, and talent development.

<Table 5-1> Business areas requiring strategic development and the most improvement

(Unit: %)

Sector	Strategic fostering	Infrastructure	Technology	Content	Ecosystem	Business model	Total
Content	40.3	10.3	16.1	29.9	29.9	11.5	97.7
Platform	36.1	5.1	14.1	9.0	62.8	9.0	100.0
Network	1.9	50.0	0.0	25.0	25.0	0.0	100.0
Device	8.8	5.3	36.8	5.3	31.6	21.1	100.0
Software	13.0	14.3	32.1	10.7	17.9	25.0	100.0

Note: The sum of the verticals for each business area adds up to 100%. The sum for the content sector may not be 100 as it includes other and non-response 2.3%.

This is plausible to a large extent as it supports the original technology of the metaverse, but the content and platform must also be strategically nurtured considering the competitiveness of the Korean industry confirmed in the survey and the thoughts of companies on future strategic development. This is because the industry believes that Korea's competitiveness in the metaverse lies in content, and that strategic development of the platform sector necessary for creating an ecosystem. Excluding the network sector, where statistical significance is difficult to determine due to the small number of observations, those seeing that the infrastructure needs improvement are very low. In addition, it has been confirmed in Chapter 4 that the overall view and the view of those working in the relevant sector are quite different in terms of the competitiveness of content and platform.

Thus, the analysis results of this report suggest that it is necessary to expand the current policy focus on XR technology and industrial applications to content and platform. Policy support for the relevant part does not mean direct subsidies for funding or tax support for content producers or platform companies. <Table 5-1> shows that the industries believe that improvements should be focused on creating an ecosystem. Therefore, it is necessary to facilitate convergence between various business areas, invest resources in required areas across the industry, such as HR development, and improve overall regulatory policy through stronger communication with the industry.

Next is the type of policy support companies need. The survey asked the respondents to select two most needed policy supports, and the results are summarized in <Table 5-2>. Apart from the policy needs of companies that usually appear in this kind of survey like financial support, developing professional skills and promoting association across different industries, generating demand, and establishing specialized educational institutions appear to have received the highest responses. These areas require policy support as it is difficult for the private sector to work on alone in the form of more sophisticated policies than direct support.

<Table 5-2> The most necessary policy support

(Unit: %)

	Primary	Secondary
Funding	37.0	14.4
Special technology development	22.2	18.5
Promotion of association with other industries	19.0	20.4
Demand generation	10.7	19.0
Establishment of specialized educational institutions	4.2	9.3
Promotion and marketing support	2.8	8.3
Other	4.2	10.2

In the end, the analysis in the previous chapter and the policy demands of companies convey the same message.

2. Human Resources Nurturing Policies

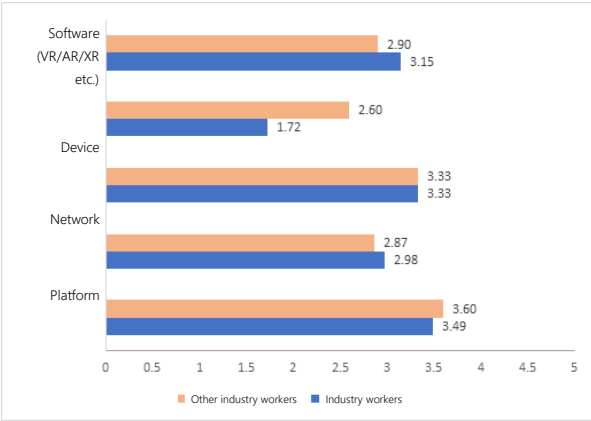
HR development is considered the most important part of industrial policy because of its large externalities and the need for coordinated policy support. The same will apply to the metaverse industry.

To identify the direction of HR development policy, let's check the level of personnel competitiveness in each sector first. The results in <Figure 5-1> are quite similar to the competitiveness scores by sector. In the case of the content industry, however, the level of personnel competitiveness self-evaluated is lower than the overall level. Therefore, considerable efforts should be focused on nurturing human resources in the field considering that the content and platform sectors have been pinpointed as the business areas Korea should focus on.

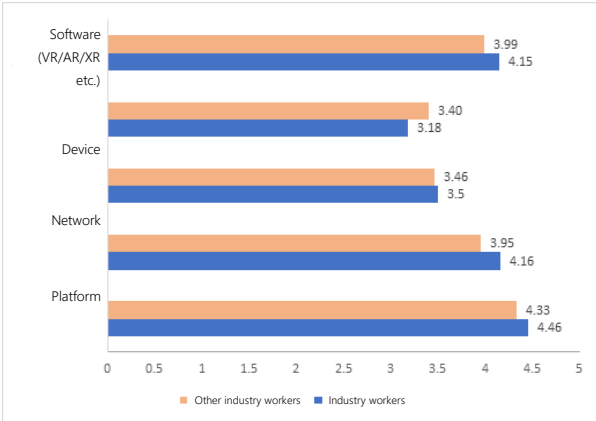
What about the qualitative aspect? <Figure 5-2> shows the results of a survey on future demand for human resources by sector. This figure also suggests that demand for content, platform, and software, where Korea has competitiveness or needs strategic development, will increase in the future. On the question about difficulties related to securing human

resources, 43.5% of the respondents answered that the HR pool in the related field is insufficient, and 31.5% answered that their expertise is an issue. The analysis results emphasize the need for policy efforts to improve the level of human resources in these fields in both quantity and quality.

[Figure 5-1] HR competitiveness by sector



[Figure 5-2] Expected HR demand growth by sector



One thing to keep in mind for HR development policies is that we are not in need of people carrying out simple developments. When asked about the jobs expected to have the most demand in relation to the metaverse, content creation and development commonly took up the highest percentage. A vast majority of companies saw the need for content-related personnel. This reveals that the companies tend to think that the fundamental competitiveness of metaverse lies in content. Next, they predicted that the demand for software development personnel, and business general manager and planning personnel would increase. The industry believes that people who will create content, build business

models, and design products will be most needed along with those in charge of the technology sector to secure a customer base and generate profits in the metaverse.

<Table 5-3> Job types expected to rise in demand

	Content	Platform	Network	Device	S/W	Total
General business management and planning	8.3	13.8	8.3	9.1	12.2	11.1
Content creation and development	68.1	60.0	66.7	72.7	46.3	61.1
Hardware development	5.6	1.3	8.3	0.0	4.9	3.7
Software development	11.1	18.8	16.7	9.1	24.4	16.7
PR and marketing	4.2	3.8	0.0	9.1	2.4	3.7
IP business	1.4	2.5	0.0	0.0	4.9	2.3
Other	1.4	0.0	0.0	0.0	4.9	1.4

Note: The sum of the verticals for each business area adds up to 100%.

Another point to note is that about 40% of respondents said they were hiring new workers, and 25% said they were using outsourcing when a demand for core job personnel arises in a company. This reflects the rapid growth of the metaverse industry and at the same time shows the difficulties in supplying the necessary personnel through companies' employee retraining alone.

The above analysis results implies that it is not desirable for the support policy to be biased only on the technical aspect, at least in terms of HR development since the current support policy is generally set up mainly for devices and infrastructure. The same applies to all digital technologies. Many studies have pointed out the necessity of developing social and organizational capabilities as well as technology utilization capabilities to respond to the 4th industrial revolution.

Section 2 Legal Issues related the Metaverse Industry

Another matter to tackle for the development of metaverse-related industries is the legal system. Despite the attention in the metaverse, relevant discussions are currently active in the industrial aspect. In the legal perspective, only early-stage discussions on NFT as a method for securing the originality of digital goods are taking place.

However, there is a possibility of various problems occurring and the decrease in the relevant industry if legal preparations are ready for the potential issues inherent in the characteristics of the metaverse in the future. In this section, let's discuss the nature of the legal issues related to the metaverse and ways to improve the system that are desirable to protect and revitalize the ecosystem.

1. Metaverse and Personal Information

A. Personal Information for using the Metaverse

1) Information collected by Metaverse Providers

According to data Meta (formerly Facebook) released recently, Facebook will ban marketing and advertising based on information, including race, ethnicity, political orientation, religion, and sexual vulnerability.[86] Other IT companies also have been collecting various information such as posts written by users, voice, travel information (navigation and map, etc.) in addition to contact information, identity verification information (resident registration number, etc.), and payment information (credit card number, account number, etc.).

The metaverse may collect not only the above information but also biometric information[87] such as iris and face depending on the type of device accessing the metaverse, as well as behavioral information like behavior patterns and habits. The range of information that metaverse service providers can collect from users will be significantly wider than at present, and their utilization may even be expanded to unpredictable ranges such as consumer discrimination as well as advertising.

In this regard, the Personal Information Protection Act of Korea currently defines personal information as follows.

Personal Information Protection Act
Article 2 (Definition) The terms used in this Act shall be defined as follows:
1. The term "personal information" means any of the following information relating to a living individual:
(a) Information that identifies a particular individual by his or her full name, resident registration number, image, etc.;
(b) Information which, even if it by itself does not identify a particular individual, may be easily combined with other information to identify a particular individual. In such cases, whether or not there is ease of combination shall be determined by reasonably considering the time, cost, technology, etc. used to identify the individual such as likelihood that the other information can be procured;
(c) Information under items (a) or (b) above that is pseudonymized in accordance with subparagraph 1-2 below and thereby becomes incapable of identifying a particular individual without the use or combination of information for restoration to the original state (hereinafter referred to as “pseudonymized information”);

According to the above definition of personal information, any information that can identify a specific individual can be personal information. Therefore, all information that

[86] *The New York Times*, “Meta plans to remove thousands of sensitive ad-targeting categories,” Nov. 9, 2021 (https://www.nytimes.com/2021/11/09/technology/meta-facebook-ad-targeting.html)

[87] Avatars provided by Naver's Zepeto, etc. are produced and provided similarly to users through face recognition.

service providers obtain from individual users through metaverse can be regarded as personal information. Since metaverse users verify their identity for use and login with ID, password, etc., all activity records after logging in are recorded as user information and fall under personal information unless separately processed.

In particular, if biometric and behavioral information is processed using certain technical means for recognizing a specific individual, it falls under the Personal Information Protection Act Article 13 Subparagraph 3, and consent to the processing of other personal information must be obtained separately.[88]

However, the method for obtaining content should be different from the current one. Although individual consent is required at present, it is necessary to structure 'informed consent' effectively for users to properly understand and consent to the content and scope of information provision and utilization.[89] Providing relevant information should be mandated for the users to understand the content and scope of information used easily and guidelines for relevant procedures should be prepared for making it easy to withdraw consent and request deletion of personal information.

2) Information acquired by other users in the metaverse

Individual users may stay alone depending on the metaverse, but mostly be active in the same virtual space as other users since the metaverse is premised on reflecting reality in a virtual space. This is the difference from the existing e-commerce, portal service, and SNS. Existing online activities are premised on personalized service, and joint activities are conducted through chatting only when others agree. However, there is a possibility of privacy violations by other users since the activities in the metaverse simultaneously occur in the same virtual space with other users.

Users perform activities in a virtual space with avatars. If the user wants to record his or her activities by way of screen shots or audio or video recording, even the activities of other users around may be saved, infringing on privacy. Let's take an exhibition held in the metaverse where user A participated. If the content of the exhibition is broadcasted or disclosed by other users and user A's avatar, etc. is disclosed together in the footage, it is subject to invasion of privacy even if user A participated in the exhibition after giving

[88] Article 18 (Scope of Sensitive Information) "Information prescribed by Presidential Decree" in the main clause , with the exception of the subparagraph, of Article 23 (1) of the Act means the following data or information: Provided, that where the public institutions process any of the following data or information pursuant to Article 18 (2) 5 through 9 of the Act, the said information shall be excluded herefrom:
1. DNA information acquired from genetic testing, etc.;
2. Data that constitutes a criminal history record defined in subparagraph 5 of Article 2 of the Act on the Lapse of Criminal Sentences;
3. Personal information resulting from specific technical processing of data relating to the physical, physiological or behavioral characteristics of an individual for the purpose of uniquely identifying that individual;
4. Personal information revealing racial or ethnic origin.

[89] For example, it is necessary to explain easily about the biometric and behavioral information for obtaining content, and to avoid pre-determining default values for optional consent.

consent. This is similar to violations of privacy in other areas like YouTube or car black boxes. In this case, the user's identity must be processed to be hidden if consent is not obtained. Some may argue that it is difficult to identify an individual since it is the avatar, etc. being disclosed within the metaverse and not the real person. However, it is possible to identify the individual if acquaintances like family members or relatives can identify an individual. Then, there is a possibility that the disclosing an avatar that reflects the individual's personality may constitute an invasion of privacy.

Thus, it is necessary to prepare various means to protect the privacy of users and prevent unexpected infringement, including user education and technical methods[90] to notify users exposed to recording of another user in the metaverse.

B. Personal Information in Trading between Metaverse Store Owners and Individuals

Various business operators other than the metaverse service provider can enter as the metaverse has a high degree of freedom. This is similar to department stores in the real world and intermediary platforms in e-commerce. While it will differ depending on the functions provided by the metaverse type, there are concerns of transaction details being disclosed to other nearby users and metaverse service providers when transactions are made through chatting or voice chatting. Transactions in the real world are made through conversation, etc. and there is a possibility of disclosure to other users, etc. in the real world. However, it is unlikely to be disclosed to third parties since the relevant contents are not recorded in by audio or videotaping. Nevertheless, personalized services should be provided to enable transactions on the metaverse as there are risks of the metaverse being recorded by a third party.[91]

C. Business Entities' Utilization of Personal Information

As mentioned earlier, the metaverse can collect more diverse and larger amounts of information than in real life and online activities. Service providers and business operators have reasons to collect as much user information as possible for the utilization of data. Therefore, service providers may want to collect transaction details and store operators to collect information from service providers through partnerships. Collected user information can be used to recommend customized products to users or the increase the level of metaverse services. Meanwhile, excessive information collection can cause problems like violating user privacy, and spreading damage when information is leaked from hacking.

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[90] Video conferencing system ZOOM notifies recorded meetings before users join a meeting and regards as consent to the recording if users participate.

[91] For example, games, deemed similar to the metaverse, allow a transaction window between characters to open, and to personalize transactions through a personalized chat function called whisper.

Therefore, the purpose of collection and utilization should be subdivided and specified, and the scope of the target information should be limited within the scope of the purpose. Currently, the scope of information collection is limited within the scope of the purpose, but in most cases the purpose is set abstractly, as in 'promotion of service.' It is necessary to explain in more detail when obtaining consent.

2. Issues related to Transactions in the Metaverse

Other than the personal information discussed above, an industrially important issue is the legal issue of transactions within the metaverse. These transactions may be deemed as transactions performed electronically considering that the metaverse is a virtual space using electronic devices. Simply thought, it would make sense to apply the Electronic Financial Transactions Act and the Act on the Consumer Protection in Electronic Commerce as they are.

The Electronic Financial Transaction Act and the Act on the Consumer Protection in Electronic Commerce differ in their purpose of enactment. The Electronic Financial Transactions Act aims to ensure the safety and reliability of electronic financial transactions made using electronic devices (Electronic Financial Transactions Act Article 1).

On the other hand, the purpose of the Act on the Consumer Protection in Electronic Commerce is to prescribing matters relating to the fair trade of goods or services by means of electronic commerce transactions (Act on the Consumer Protection in Electronic Commerce Article 1 Act). Accordingly, the Act recognizes the consumer's right to cancel orders (Act on the Consumer Protection in Electronic Commerce Article 17) as a contract is concluded without actually seeing the goods due to the distance between the parties to the transaction. This is similar in overseas. Article 9 (2) of the EU Consumer Rights Directive (2011/83/EC) prescribes the right to withdraw orders in the case of transactions between remote parties such as online transactions.

Transactions within the metaverse differ in specific methods depending on the type and method of the metaverse. Transactions made between a consumer and a business through conversation in the form of voice and chat within the metaverse is difficult to be deemed a transaction between remote parties. However, if the actual business operator does not respond, such as by using AI, it is difficult to be deemed a real-time transaction. It is hard for consumers to recognize whether (s)he is actually talking to a business operator when sophisticated AI is used, and most transactions use a standardized form.

Thus, the Act on the Consumer Protection in Electronic Commerce should be applied to protect consumers. Further, the Electronic Financial Transaction Act and the Financial Consumer Protection Act should be applied to financial transactions.

Currently, transactions in the metaverse deal with not only real goods but also various digital goods. The Act on the Consumer Protection in Electronic Commerce Article 17 (2),

the cancellation of orders for digital goods is limited if the provision of any services or digital content defined. The problem is whether digital goods provided in the metaverse fall under digital content. For example, Gucci's virtual products have been traded on the metaverse recently. In such case should digitalized real objects be considered a digital content? The Framework Act on the Promotion of Cultural Industries Article 2 Subparagraph 5 defines digital content as "materials or information, such as codes, letters, diagrams, colors, voices, sound, images or videos (including the combination thereof), which are manufactured or processed in the digital form so as to enhance the usefulness of the preservation or utilization thereof" and classifies game items as digital content. Therefore, virtual goods in the metaverse can also be viewed as digital content, and it is appropriate to apply the Act on the Consumer Protection in Electronic Commerce.

3. Metaverse and Digital Goods

A. Ownership and Copyright of Digital Goods

Among the objects traded in the metaverse, possession and ownership are identical for actual goods as the possession of goods moves to the user after the transaction. There is no problem of ownership since users can exercise actual rights to real goods without the help of others. There have been discussions about their ownership in the past concerning digitized images and sound sources. In general, the concept of uniqueness was difficult to implement since infinite reproduction of digital goods makes it hard to distinguish between the original and the copy. Thus, concept of ownership could not be commonly used in the digital world. Moreover, the Civil Act Article 211 stipulates that "an owner has the right, within the scope of law, to use, take the profits of, and dispose of, the article owned." Therefore, the owner can dispose of the property or seek profit based on it. As it is difficult to implement uniqueness for digital goods, the author's economic rights and moral rights lie in the copyright holder under the Copyright Act, and the owner only holds the right to use and dispose of digital goods (excluding transfer to others). Representative examples are game items, e-books, video, and sound sources.

The recent facilitation of blockchain technology enabled the development of NFTs, allowing digital goods to be given originality. It is possible to confirm originality and uniqueness of real goods digitized through scanning or made digitally from the beginning as they are given unique information and impossible to reproduce even if they look the same on the outside.

Thus, NFT-applied digital goods may be permitted their transfer to others, which was previously restricted for digital goods, since they cannot be reproduced. It is still necessary to review whether the owner can distribute even if the originality is recognized. The Copyright Act Article 20 stipulates that the author "shall have the right to distribute the

original or copy of his or her work: Provided, That if the original or copy of the work has been offered to a deal by means of sale, etc. with permission of the relevant holder of author's economic right, the same shall not apply." This is deemed the right to typical pieces of work. On the other hand, it is a common interpretation in the US and Korea to recognize as the 'permission or license' rather than transfer for digital goods.[92] Digital goods whose originality is difficult to recognize it is applied the concept of transmission, which means data movement, rather than distribution accompanied by transfer of possession while transmission is regarded as a matter requiring the approval of the copyright holder or the holder of author's economic rights. Therefore, a video or sound source digitally purchased requires approval of the copyright holder or author's economic right holder to transfer (transmit) it to another person.

However, it is easy to confirm the true owner and transfer of ownership since originality and uniqueness can be recognized in the case of digital goods to which NFT is applied, unlike existing digital goods. It is legally appropriate to treat NFT-applied digital goods similarly to tangible goods, rather than the same as duplicable digital goods. To this end, the current copyright law should be further clarified. The Copyright Act defines transmission as "public transmission[93], which refers to making works, etc. available for use so that members of the public can access them at a time and place individually selected, including transmissions made accordingly," (Copyright Act Article 2, Subparagraph 10) i.e. transfer by means of communication, etc. By contrast, distribution is stipulated as "a transfer by assignment or lending of the original or its copies to the public for free or at charge" (Copyright Act Article 2, Subparagraph 23). Although the distribution method does not stipulate tangible transfer of possession as a requirement, it is premised as such considering the concept of transmission discussed above. However, it is not reasonable to distinguish it from distribution given that the concept of distribution does not specify a method and that it is possible to verify the originality and the true owner in the case of NFT-applied digital goods. Therefore, the Copyright Act should clarify the relevant regulations to recognize the originality of NFT-applied digital goods and interpret them authoritatively as distribution by transmission method, or to limit transmission to copies rather than originals.

Once issues concerning copyright, etc. are resolved, users who purchase NFT digital goods can be recognized the same level of ownership as in-kind if the originality of NFT-based digital goods is recognized. In such a case, the purchaser of NFT-based digital goods can be deemed acquiring complete ownership, rather than simply acquiring a right to use or license.

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[92] Capital Records v. ReDigi(Shin, Chang-hwan, 「A Study on Digital Copyright Exhaustion Theory」, Doctoral dissertation, Graduate School of Seoul National University (2018): 84-105).

[93] "Public transmission" means transmitting works, stage performances, phonograms, broadcasts or database (hereinafter referred to as "works, etc.") by making such available to the public by wire or wireless means so that the public may receive them or have access to them.

However, there is a limit to equating NFT-based digital goods with physical goods. In-kind does not necessitate any other medium for the transfer of ownership.[94]

In the case of NFT-based digital goods have no choice but to depend on the nodes of the blockchain for originality, recognition and change of ownership, etc. if they are not in the form of a public blockchain as they are based on blockchain. In other words, it has a limitation that originality cannot be proven if there is no blockchain participant.

B. Standardization and Distribution of Digital Goods, etc.

Existing digital goods have been distributed in various ways depending on whether they are standardized or not. Video and sound sources have been distributed in a way that is transmitted to buyers, etc., and can be used without a dedicated device or program when produced in a standardized form such as MP3. While the use of non-standardized digital goods such as game items and e-books are limited without dedicated devices, the issue of standardization has little to do with distribution because purchasing existing digital goods has been seen as similar to a right to use.

NFT-based digital goods can be recognized for their uniqueness, so ownership can be recognized, not the right to use. But their distribution and utilization differ as ownership of NFT-based digital goods may be infringed depending on whether they are standardized or not. If NFT-based digital goods can only be used in a specific metaverse or device (program), the ownership may be infringed by the metaverse service provider and the device manufacturer. For example, if a user purchase NFT-based digital goods from Roblox only available on Roblox, the user cannot use the goods on other devices or programs. In case Roblox closes for various reasons, there is a concern of Roblox' infringement of the user's ownership. Therefore, unstandardized NFT-based digital goods will have limitations in distribution and utilization and the fact should be explained to users in an appropriate way during the transaction process.

When NFT-based digital goods can be standardized, they can be used on general-purpose devices rather than specific devices as in the case of drawings, for instance. Thus, the distribution of NFT-based digital goods is expected to be carried out by transmitting information about digital goods in a block chain or transferring possession of a storage device containing the information. In this case, NFT is used as a means of proving the uniqueness and originality of digital goods. Even in this case, it is difficult to secure the continuity of the blockchain in the case of Public Blockchain and Private Blockchain as mentioned above since NFT is based on blockchain. It has the disadvantage that the proof of ownership depends on others.

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[94] In the case of real estate, a register is used, but a register records changes in ownership, etc., and it does not mean that ownership does not transfer even if it is not recorded in the register.

4. Governing Law of the Metaverse

As the metaverse is a virtual space, cross-border transactions can easily occur. In this sense, the governing law can be an important issue concerning which laws to apply to legal relations and illegal activities between the parties. Another crucial matter in the case of a basic contract of use of the metaverse or a contract of sale of goods within the metaverse is which nationality of the business operator and the user, or the seller and the buyer should be used as the basis for the governing law. Moreover, the applicable law may become an issue if a user infringes the copyright of another person in the metaverse. There will be issues related to the governing law in the case of copyright infringement in the metaverse as to matters such as whether to judge based on the nationality of the infringer or the purchaser, whether to base the country of access rather than nationality, whether to base the server location for the metaverse service, etc.

The Act on Private International Law prescribes the governing law, and the general principle is that the governing law is determined by agreement between the parties.[95] If there is a special purpose, however, such as protecting persons with incompetent conduct, including minors, etc., it stipulates the law that will take precedence over the agreement of the parties. In the metaverse, contractual governing law is determined by utilizing terms and conditions. This may be deemed a designation of the governing law by agreement between the parties, and the governing law will be determined under the Act on Private International Law for consumer contracts and torts.

A general aspect of the metaverse is the act of trading goods in the metaverse. While the transactions within the metaverse can be applied the Act on the Consumer Protection in Electronic Commerce as discussed above, there are elements different from general e-commerce. General e-commerce distinguishes domestic transaction and overseas direct purchase, but it is not clear in the case of metaverse. If a Korean national living in Korea purchases a Gucci bag in the form of digital goods from Roblox or Zepeto, it is a transaction from an Italian business operator. Here, there is a problem of whether the user can clearly recognize that (s)he is purchasing from an foreign business and whether the Korean e-commerce law can be applied as it is. Recognition of transactions with foreign businesses can be resolved through indications, etc., but the governing law will be determined in accordance with the Act on Private International Law. The Act on Private International Law Article 27(1) stipulates that the mandatory provisions under consumer related laws may be applied where a business entity encourages a consumer to place an order in a country other

[95] Act on Private International Law Article 8 (Exception to Designation of Applicable Law) (1) Where the applicable law designated under this Act is slightly related to the corresponding legal relationship and where the law of another country most closely related to such legal relationship obviously exists, the law of the other country shall govern. (2)Paragraph (1) shall not apply if the parties choose the applicable law by agreement.

than his or her country of habitual residence. [96] It is not clear whether the mandatory provisions of Korean consumer laws should be applied because it is unclear whether transactions with foreign businesses in the metaverse are transactions abroad or within Korea.

Hence, it is necessary to reflect the characteristics of the metaverse and internationally consistent interpretation and improvement of private international law to clarify the legal relationship within the metaverse.

[96] Article 27 (Consumer Contract) ① Even where the parties to a consumer contract choose the applicable law, the protection given to the consumer pursuant to the mandatory provisions of the country in which the habitual residence of the consumer is located shall not be deprived.

1. Where a business entity engages in occupation or business activities, such as solicitation for transactions through advertising, before the conclusion of a contract or where a business entity engages in occupation or business activities, such as solicitation for transactions through advertising in a territory not included in the consumer's country, and where the contract falls under the scope of the business entity's occupation or business activities;
2. Where a business entity receives an order from a consumer in the consumer's country;
3. Where a business entity encourages a consumer to place an order in a country other than his or her country.