

Metaverse and virtual tech in south korea

Outlook report



ICDK SEOUL



MINISTRY OF FOREIGN AFFAIRS
OF DENMARK

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ISBN: 978-87-85248-09-1

Executive summary

‘Metaverse’ is often used as common term for a virtual world that requires new technologies such as Extended Reality (XR), digital twin, blockchain, artificial intelligence (AI), data analytics, cloud, etc.

In Korea ‘Metaverse’ became a buzzword among stock investors in the early days of COVID-19, as the usage of online communication platforms sharply increased due to social distancing movements. The interest and needs for more immersive technology to address challenges of existing platforms and technologies rose significantly.

The buzzword quickly turned into one of the most potential and strategic technologies among industry leaders to the extent that the public sector started to incorporate metaverse into its service. For instance, the Seoul Metropolitan Government (SMG) announced to become the first city to enter metaverse in late 2021.¹

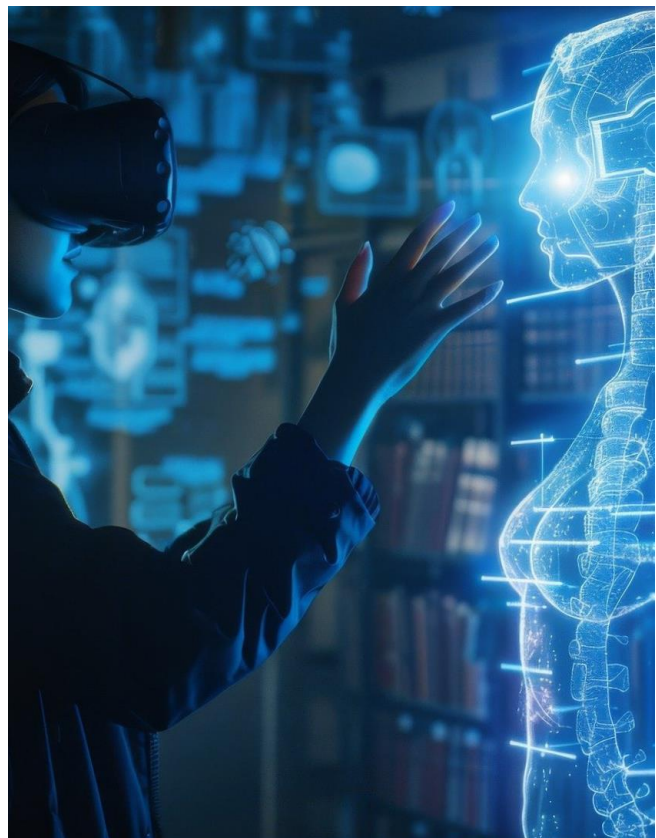
Throughout the development progress the next year, SMG officially rolled out the first phase of its virtual municipal world ‘Metaverse Seoul’ in January 2023.² In the meantime, a large number of corporates, start-ups, research institutions as well as authorities, have engaged in multitudinous metaverse technology and services, leading to a vibrant ecosystem.

March 2024, Korea’s Ministry of Science and Information and Communication Technology (MSIT) announced to create a KRW 50 billion (DKK 260 million) metaverse fund.³

This initiative was part of the Korean government’s efforts to foster growth and innovation in the XR, AI and creative technology industry.

Such vigorous development and investment brings mutually beneficial and potentially complementing areas of collaboration between Denmark and Korea for more innovative and sustainable virtual era.

In general, the opportunities for the Danish R&D institutes and businesses lie across sectors and technologies, accelerated by the Danish, Korean and EU programs, but the bottom line is to work together towards a shared vision – to create a safer and more responsible metaverse.



¹ [The Washington Post: https://www.washingtonpost.com/world/asia_pacific/metaverse-seoul-virtual/2021/11/27/03928120-4248-11ec-9404-50a28a88b9cd_story.html](https://www.washingtonpost.com/world/asia_pacific/metaverse-seoul-virtual/2021/11/27/03928120-4248-11ec-9404-50a28a88b9cd_story.html)

² [Seoul Metropolitan Government website: https://english.seoul.go.kr/official-release-of-metaverse-seoul/](https://english.seoul.go.kr/official-release-of-metaverse-seoul/)

³ [The Picktool: https://www.thepicktool.com/south-korea-invests-38m-in-metaverse-fund-for-smes/](https://www.thepicktool.com/south-korea-invests-38m-in-metaverse-fund-for-smes/)

Objective of the report

The Korean government set a goal to have the world 5th largest market share in metaverse by 2026.⁴ This requires four major investments in the area of talent, infrastructure, ecosystem, and governance. To achieve the goal, international cooperation as financial support will be one of the key enablers.

In line with above ambition, our report has two main objectives. One is to strengthen relevant take-home knowledge for Danish technology and digitalisation stakeholders who would like to be informed about and inspired by Korean practices and development. This includes clusters, universities, start-up communities, researchers, businesses, and authorities. The other is to identify concrete areas of collaboration, which are aligned to Korea's public initiatives, market potential and R&D trends, for Denmark, especially for but not limited to researchers and businesses.

Therefore, this report first provides an overview of metaverse ecosystem and stakeholders in Korea. It is followed by R&D landscape by four application fields: creative industry, healthcare, social science and humanities and education, which are the most burgeoning areas in Korea. Last but not least, it outlines the collaboration opportunities for different types of stakeholders.

Metaverse Ecosystem in Korea

There are opposing views towards metaverse at the moment. Since it peaked in late 2021, the search volume of 'metaverse' in Google or Naver, the largest search engine in Korea, has dropped. Some say the public lost interest due to its ambiguous concept and limited services they could experience until now.

On the other hand, industry players, public sector, and academia have stayed positive in the adoption and further investment on the topic. One expert stated the background of this polarizing trend in an article as it is because metaverse is now more than a passing trend with clearer conceptual and technological definition.⁵

Both public and private sector is getting prepared to the economic ripple effect of the metaverse and its influence on ecosystem. Proactive policies that aims to strengthen the competence in the metaverse at the national level are also in the game. This section will further look into the initiatives from governments and industrial players that have shaped the continuing development of metaverse in Korea.

a. Government strategy and initiatives

Korean government has taken several proactive steps to advance its metaverse ecosystem. Through strategy building, regulatory support and technological infrastructure development, it has been fostering public-private partnerships, advancing workforce skills and advocating responsible growth of metaverse industry.

⁴ Korea Herald: <https://www.koreaherald.com/view.php?ud=20220120000709>

⁵ iT dongA: <https://it.donga.com/103463/>

i. Pan-governmental strategic blueprint of Metaverse

January 2022, MSIT unveiled the country’s long-term roadmap to foster its metaverse industry, with the aim of becoming the world’s fifth-largest market by 2026. By the time of announcement, Korea was yet ranked 12th in the world. In particular, authorities laid out four major goals -- activating the ecosystem for metaverse platforms, nurturing professionals, fostering companies and setting up a safe environment for all metaverse users. The plan pledged to nurture 40,000 professionals and 220 companies specialized in metaverse technology, and to provide financial aid up to KRW 5.5 billion (DKK 28.6 million) to nourish young talent and students.⁶

In order for the above goals to bring sustainable value and impact, the government also shared its vision to strengthen the metaverse infrastructure across the country. By setting up a National metaverse hub, it aims to provide space and facilities to support start-ups and creators.

Meanwhile, Naju City, located in southwest of the country, has been selected by MSIT to build and run the

National Metaverse Hub.⁷ With the budget of KRW 1.9 billion (DKK 9.88 million) and a goal to start running the cluster in 2025, it will support users to take short educational courses, form a consultative group with industrial experts, and run Proof of Concept (PoC) of metaverse content.

This blueprint and its actual implementation so far implies that the development of relevant technologies including Virtual Reality, Augmented Reality and motion capturing will be spearheaded by the private sector while the government will play a role of supporter with a wide range of measures, laws and regulations.

Figure 1. Overview of Pan-governmental strategic blueprint of Metaverse.



⁶ [The Korea Times: https://www.koreatimes.co.kr/www/tech/2022/01/133_322579.html](https://www.koreatimes.co.kr/www/tech/2022/01/133_322579.html)

⁷ [M News: https://n.news.naver.com/mnews/article/468/0001057604?sid=102](https://n.news.naver.com/mnews/article/468/0001057604?sid=102)

ii. Metaverse Seoul and its Ethics Guide

While a number of ministries have joined efforts to raise the country's general competency on metaverse industry with the pan-governmental strategic blueprint, Seoul Metropolitan Government (SMG) has been leading the development and implementation of metaverse for public service in a city level.

SMG's initiative to replicate Seoul in a virtual world was announced in 2021 and became a reality in January 2023. Following the pilot version in 2022, the first phase of Metaverse Seoul was launched providing administrative services in the area of economy, culture and tourism, education and civil services.⁸

Until now there are six main services that Metaverse Seoul provide such as citizen participation, industry support, youth counselling, tax support, document issuance, and chat service⁹. For example, the Virtual Avatar Counselling Centre helps young citizens find support with issues that can be intimidating to speak face-to-face.

The city has committed KRW 224 billion (DKK 1.165 billion) to develop its infrastructure, with the upcoming second phase in 2024 with focus on expanding public services such as connecting local businesses with foreign investors¹⁰. The third phase, planned in 2026, is when Metaverse Seoul in largely integrated into the city's daily operations.

Meanwhile, Seoul Digital Foundation unveiled Metaverse Seoul Ethics Guide in December 2022¹¹, right before the official launch of the platform. The guidelines are intended to prevent verbal violence, sexual harassment, personal information, and copyright infringement between avatars that may occur in a metaverse environment

In addition, it goes beyond the ethical principles of the metaverse and presents specific dos and don'ts behaviour that must be observed by each subject of actual users, creators, developers, and operators.



By 2030, Korea expects to see more of Metaverse Seoul for different cities. Nearly 700 cities are engaged in applying some form of virtual technology into their public services, adding its weight to keep the momentum of the country's leading position in OECD Digital Government Index.

Figure 2. Metaverse Seoul Platform¹²

iii. Basic Principles for the Protection of Metaverse Users by Korea Communications Commission (KCC)

⁸ [The Korea Times: https://www.koreatimes.co.kr/www/tech/2024/05/129_343778.html](https://www.koreatimes.co.kr/www/tech/2024/05/129_343778.html)

⁹ [Seoul Metropolitan Government Website: https://english.seoul.go.kr/policy/smart-city/metaverse-blockchain/#none](https://english.seoul.go.kr/policy/smart-city/metaverse-blockchain/#none)

¹⁰ [Korea Business News: https://koreabusinessnews.com/tech/1222](https://koreabusinessnews.com/tech/1222)

¹¹ [The Seqye: http://www.theseqye.com/news/view/1065582573524767](http://www.theseqye.com/news/view/1065582573524767)

¹² [Photo from Seoul Metropolitan Government Website](#)

A year after the release of Seoul Digital Foundation's ethics guide, KCC announced a set of autonomous norms that focuses on the right of users including children and adolescents. Under the name of 'Basic Principles for the Protection of Metaverse Users', it presents six rules that are recommended to metaverse developers and service providers.¹³

One of the principles states that communication and exchange through the medium ensures self-realization and freedom of expression as much as possible, but also protects universal and valid community values based on mutual respect and consideration. Another principle ensures that users understand the principles and policies of the operation of products and services, and to have appropriate procedures to present their opinions on matters related to user rights and interests.

There is also a principle that covers the long-term impact of the metaverse by disclosing efforts for the UN Sustainable Development Goals of products and services and studying the correlation between metaverse and users' physical and mental health as well as the impact on society, culture, environment, and economy.

Additionally, KCC proposed a code of practices that includes specific measures to protect users, including restrictions on sexual harassment and stalking of avatars, reporting and sanctioning cyberbullying, and the right to transfer non-fungible tokens (NFTs) buyers so that operators can autonomously reflect the basic principles.

Major Metaverse companies such as Naver, SK Telecom, and Meta also agreed to the principles, and decided to reflect them in their future terms and conditions and service operation regulations.

iv. Virtual Convergence (Metaverse) Industry Promotion Act

A regulatory framework which is designed to systematically foster virtual convergence industries and services, and pre-emptively improve regulatory issues arising from convergence between various industries and technologies is on the way. A bill to enact the "Virtual Convergence Industry (Metaverse) Promotion Act" aimed at boosting the virtual convergence industry and improving regulations was passed in February 2024¹⁴, expecting to take effect since August 2024. MSIT is leading the process of preparing subordinate laws such as enforcement ordinances and enforcement regulations, arguing that it would be the world's first law to promote the metaverse industry.

Based on the consensus that independent laws are needed to promote the virtual convergence industry, the bill was first proposed in the National Assembly in January 2022. The bill approved two years later is known to combine three bills launched in 2022: the Metaverse Industry Promotion Act, the Virtual Convergence Economy Development and Support Act, and the Metaverse Industry Promotion Act.

The main contents of the bills are the creation of a promotion system and foundation for the promotion of the virtual convergence industry, the development of virtual convergence technology and services, and support for commercialization. It also includes frameworks for pre-emptive regulatory innovation,

¹³ Donga Daily: <https://www.donga.com/news/article/all/20231130/122419749/1>

¹⁴ The Picktool: <https://www.thepicktool.com/s-koreas-metaverse-act-to-drive-digital-economy/>

establishment of a private-centred self-regulatory system, user protection, and creation of a sound virtual convergence world ecosystem.

Meanwhile, at the end of 2023, the same ministry revealed the Metaverse Code of Conduct that embodies the eight practical principles of the Metaverse Ethical Principles to innovate the metaverse ecosystem and create a self-regulatory culture.¹⁵ The eight principles of practice are authenticity, autonomy, reciprocity, respect for privacy, fairness, privacy, inclusion, and accountability, and each principle presents specific behavioural patterns that members of the metaverse ecosystem should apply and pursue in the field.

These initiatives show that the government is making various efforts to promote the industry and innovate the ecosystem.

b. Investments

Strategic funding and investment is also what has contributed to the burgeoning of the metaverse industry in South Korea. Both public and private sector played a significant role in this initiative, especially focusing on nourishing talents, SMEs and start-ups.

MSIT announced in February 2024 that it plans to provide a total of KRW 119.72 billion (DKK 622.54 million) the same year to foster the metaverse industry.¹⁶ The funding will feed into five categories: platform development, workforce training, business support, R&D, and establishment of regulatory framework. The largest portion of the finance, one third of the total, will be distributed for the platform development in which the government leads projects to develop metaverse business models especially in the area of XR contents converged with various digital technologies such as large-scale AI. In addition, it will continue to support the development and demonstration of AI-Metaverse disaster safety management systems to predict and respond quickly to various disasters and accidents following last year.

Another one third goes to local businesses and SMEs through regional Metaverse Hubs and advisory services. The hubs will be a go-to infrastructure that supports testing, Proof of Concept, and demonstration of relevant technologies including hologram, XR devices, and 3D contents. Furthermore, the regional hubs will provide advisory services for South Korean SME's looking to pursue international opportunities.

In order to accelerate the growth of SMEs in the sector, the Metaverse Fund worth KRW 50 billion (DKK 260 million) has been created since 2022 yearly to invest in promising entrepreneurs¹⁷. As for the fund formed in 2024, 60% of the total amount – which is coming from the government investment – will be reinvested from the former Digital Content Korea Fund. This ensures a stable investment in which virtuous cycle of investment-recovery-reinvestment continues.

¹⁵ [Korean Government Policy Briefing: https://www.korea.kr/news/policyNewsView.do?newsId=148924147](https://www.korea.kr/news/policyNewsView.do?newsId=148924147)

¹⁶ [e-Daily: https://n.news.naver.com/mnews/article/018/0005682241?sid=105](https://n.news.naver.com/mnews/article/018/0005682241?sid=105)

¹⁷ [Newdaily: https://biz.newdaily.co.kr/site/data/html/2024/03/18/2024031800225.html](https://biz.newdaily.co.kr/site/data/html/2024/03/18/2024031800225.html)

On the private side, the year of 2021 was the peak for Venture Capital investment in Metaverse. During the pandemic, alongside with digital healthcare and AI, Metaverse became one of the most popular area to invest in according to a survey conducted by the Ministry of Start-ups and SMEs (MSS) in late 2021.¹⁸

The trend led to a historic record of a XR start-up becoming a Unicorn, a company which gets valued at more than KRW 1 trillion (DKK 5.2 billion), in the shortest period of time in the industry. VA Corporation, which broke this record, runs the largest virtual studio in Asia with its virtual production capability¹⁹.

Though these breaking-news type of large-scale investments has subsided as of 2024, interest in the metaverse has not disappeared. Start-ups that are seeking to dominate the market such as AmazeVR²⁰ (VR concert service provider), Anipen²¹ (metaverse content development platform), and NdotLight²² (3D content creation tool developer) have been succeeded in attracting investments almost every year, and investments in other SMEs that produce virtual characters are still being made. New businesses continue to emerge at the same time.

Given that it takes time to build the infrastructure for a new industry to settle down and requires enough time for users to adapt, the metaverse is still considered a new industry with potential by the investors and key industrial players.

c. Key stakeholders and focus areas

The metaverse ecosystem in Korea has been growing around four main areas as in the table below. The metaverse platform 'Zepeto' by Naver is leading the platform market, whereas some of the competitors have downsized the platform business since pandemic started to diminish.

In terms of infrastructure within a set of technologies that would realise metaverse, a number of large telco/IT companies have been investing in 5G, cloud, and AI services, while having slightly different focus and business areas to each other. For example, since Naver provides the largest search engine and map service in the country, it has been expanding its businesses around Digital Twin. Whereas KT, one of three major telecommunications companies, has been heavily investing on B2B cloud service based on its existing customer base.

Also known for having a strong e-sport sector, Korea has a number of game developers who are looking into VR games. Some of the game developers - such as Devs United Games and Stoic - has recently discussed collaboration opportunities with Meta, potentially looking in to a XR game market, which is expected to grow by 200 million users by 2025.²³

¹⁸ EPNC: <https://www.epnc.co.kr/news/articleView.html?idxno=218104>

¹⁹ edaily: <https://www.edaily.co.kr/news/read?newsId=01561286632263320&mediaCodeNo=257>

²⁰ AmazeVR Website: <https://www.amazevr.com/>

²¹ Anipen website: <https://www.anipen.com/en/>

²² NdotCAD website: <https://www.ndotcad.com/>

²³ Digital daily: <https://n.news.naver.com/mnews/article/138/0002174423?sid=105>

Virtual Effects (VFX) is another fast growing area due to the rise of Over The Top (OTT)²⁴ media services and popularity of Korean firms and series in the recent years. For instance, Gulliver Studio worked on VFX of Squid Game – a Korean Netflix series and the winner of 6 Emmy Awards in 2022 – creating radical growth of the company.

Developments in hardware and virtual marketplaces are relatively stagnant, but has potential to grow. Global developers such as Microsoft, Meta Platform, and OpenSea have been dominating the domestic market in this area, there are high chances for Samsung and LG Electronics to dive into Augmented Reality glasses or Head-mounted devices in near future.

Experts project that further hardware developments will be done in collaboration with global tech companies. For example, Samsung Electronics, Google, and Qualcomm announced to collaborate on new XR device on January 2024²⁵, implying potential competition with Apple and Meta.

Platform	Network/infrastructure	Gaming and Non-Fungible Tokens	VFX/Contents
Naver Zepeto	Naver Cloud/AI	Nexon	Dexter Studio
SKT Ifland	SKT 5G/Cloud/AI	NC Soft	VA Corporation
HYBE Weverse	KT 5G/Cloud	Netmarble	Giant Step
	LG U+ 5G/Cloud/AI	Devs United Games	West World
	Megazone Ckoud	Stoic	Gulliver VFX
	Kakao	Doonamu Upbit	AmazeVR
		Bithumb	

Table 1. Key stakeholder map

Among many metaverse companies across sectors, metaverse platforms could be highlighted in terms of representativeness and popularity within the country. With 23 million active global users per month (2023), 'Zepeto' is the largest virtual platform with avatars developed by a subsidiary of the Korean IT group 'Naver'.²⁶ Renowned for the most used search engine in the country, Naver launched Zepeto service since

²⁴ Over-the-top media service (simply OTT) is a digital distribution service offered [directly to viewers](#) via the [public Internet](#) – often through platforms such as Netflix and [Amazon Prime Video](#). OTT bypasses cable, [broadcast](#), and satellite television platforms—the media through which companies have traditionally acted as controllers or distributors of such content. This content may include shows and movies for which the OTT acquired licensed rights from the content owner.

²⁵ [Investopedia: https://www.investopedia.com/google-and-samsung-set-to-use-new-qualcomm-vr-chip-could-compete-with-apple-and-meta-8422266](https://www.investopedia.com/google-and-samsung-set-to-use-new-qualcomm-vr-chip-could-compete-with-apple-and-meta-8422266)

²⁶ [NAVER Z website: https://www.naverz-corp.com/](https://www.naverz-corp.com/)

2018. Within two years, the number of users reached 0.3 billion of which 80% is generation Z and 90% is from outside of the country including Indonesia, Brazil, Thailand, and the US.

Zepeto is often called Asian Roblox, but it is differentiated from Roblox in the way that Zepeto is a virtual social media platform based on User Generated Content rather than a gaming platform. One of the key characteristics of Zepeto is the fact that users can easily create avatars using AI and AR technology that look similar to themselves, which generation Z largely enjoys as a form to express themselves. Avatars can also put on different clothes and accessories, either for free or by purchasing virtual items. Once they make virtual figures, they can choose to wander around, communicate with other avatars from all around the world, attend events, or visit virtual shops.

Individual users can also become a creator for avatars or contents. They can create items for avatars such as clothes and accessories, or customize or repaint the avatars. Through these activities, the creators can monetize and contribute to activation of the platform. Monetization is done through Zem, a virtual currency within Zepeto.

Similar to other social media platforms, advertisement is one of Zepeto's revenue streams. This means, not only individuals actively use the platform. For example, global fashion brands such as Gucci, Ralph Lauren, Zara and Ugg showcased their new collections on Zepeto with virtual models, nudging users to visit physical stores.

Many more brands including sports (Adidas, Nike), cosmetics (Nars, Christian Dior), K-pop (BTS, Blackpink, ITZY), and other brands (Samsung Electronics, Hyundai Motor, Lotte World, etc.) collaborate with Zepeto to run stores or events in the platform. Once, Nike sold 5 million virtual items for Zepeto avatars, overriding the number of sales offline²⁷.

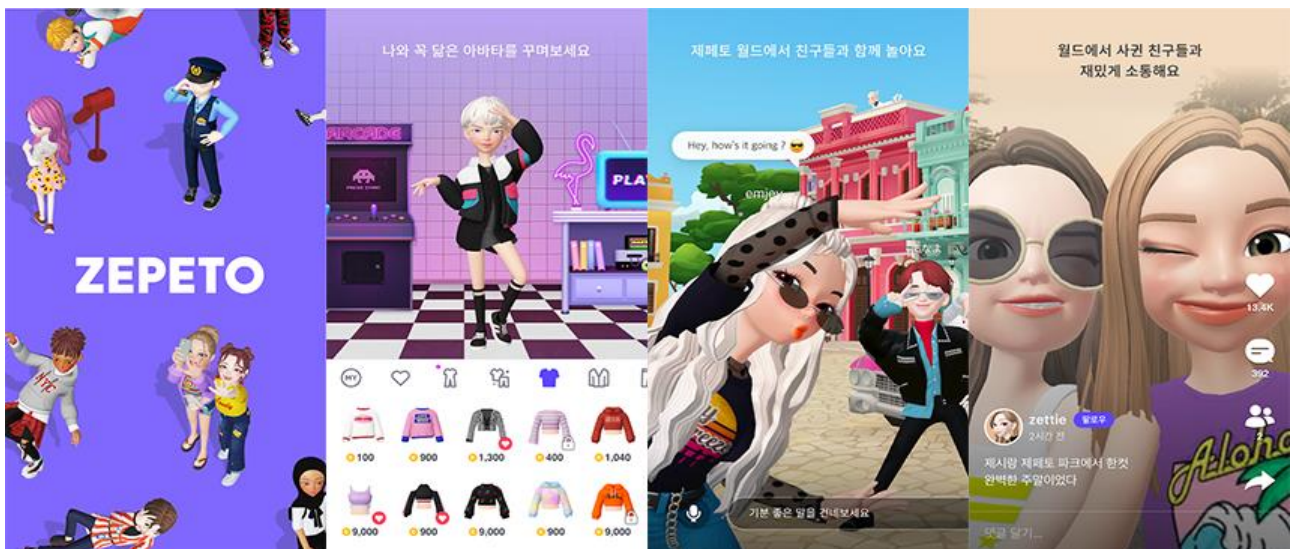


Figure 3. Screenshots of Zepeto app²⁸

²⁷ [Hotel and Restaurant Magazine: https://brunch.co.kr/@ashlistar/137](https://brunch.co.kr/@ashlistar/137)

²⁸ Photo from [Diving into the Metaverse with ZEPETO | Unity Blog](#)

R&d Trends

From 2012 to 2016, approximately KRW 283 billion (DKK 1.472 billion) was invested in 1,065 government R&D projects in the VR/AR area, recording an annual increase of 37%. Since VR/AR was included in the top 13 innovative growth engines in 2017 by the Korean government, the Ministry of Culture, Sports, and Tourism, Ministry of Trade, Industry and Energy, and MSIT have invested at least KRW 244 billion (DKK 1.269 billion) in R&D over the three years from 2018 to 2020.

The grant was used in VR/AR element technology and development of core parts, devices, and contents. Through the 'Pan-governmental strategic blueprint of Metaverse' announced in 2022, KRW 556 billion (DKK 2.891 billion) was invested in the overall revitalization of the ecosystem, including the establishment of an R&D roadmap.

In early 2024, the Korean government announced that it would invest KRW 61.9 billion (DKK 321.88 million) in the metaverse alone²⁹, while selecting six major digital technologies as AI, AI semiconductors, 5G and 6G, cybersecurity, quantum, and metaverse.

The amount of investment in the metaverse tends to slow down, especially as a large budget is concentrated on AI and AI semiconductors due to the boom of generative AI.

Nevertheless, the Korean Government announced that it would invest KRW 10.9 billion (DKK 56.68 million) in developing "core technologies for hyper-realistic content" to overcome the limitations of realization and synchronization of digital spaces and develop technologies based on industrial demand for the spread of all industries.

Especially four scientific fields are expected to benefit from Metaverse-technologies: creative industry, healthcare, social science and humanities and education.

Createch	Healthcare	Social Science and Humanities	Education
3D object generation/extraction from media	XR training	Digital human trust	Effectiveness of XR education
Real-time rendering tech	Safer surgery option	Self-identity/motivation of users	Best model for virtual training
Real-time UI/UX (human centric)	Use of VR for mental health	Effectiveness of communication	

²⁹ ZDNet korea: <https://zdnet.co.kr/view/?no=20240416083406>

Table 2. R&D topics by scientific fields

a. Createch

It is live entertainment, media, film, and gaming industry that will face breakthroughs from advancement of core technologies for hyper-realistic metaverse. The Korean government has been especially focused on creating a number of R&D projects to develop five core technologies for creation, composition, and application of metaverse such as wide area meta-space, digital human, hyper realistic media, real-time User Interface/User Experience (UI/UX), and decentralised/open platform.

All of these technologies apply to the creative industry, but developing hyper realistic media is one of the key R&D areas to look into. One topic is to extract and generate 3D object or space from 2D media which is key to creating entertainment and creative content.

Real-time rendering is also a crucial aspect of VR, and more advanced graphical processing units (GPUs) will become a key enabler that researchers will dive into. In other words, the metaverse experience requires more responsive rendering than high-quality image frames.

In April 2024, LG Electronics' technology on recreating 3D space based on 2D images got selected as top 5% research paper from The International Conference on Learning Representations 2024³⁰, a globally conference renowned for presenting and publishing cutting-edge research on all aspects of deep learning.

Another essential R&D topic for creative industry is real-time UI/UX. In South Korea, certain ongoing research projects are investigating UI/UX design for immersive interactions between space, objects and other avatars.

Traditionally, the mouse is considered an important part of a computer, and the touch screen is that of a smartphone. The development of UI/UX in the metaverse will focus on R&D on interfaces that utilize multiple senses with real-time as a top priority³¹.



³⁰ [Dailyimpact: http://www.dailyimpact.co.kr/news/articleView.html?idxno=115658](http://www.dailyimpact.co.kr/news/articleView.html?idxno=115658)

³¹ According to the Metaverse Technology and Standards Trends and Directions for R&D Promotion Report by Institute of Information & communications Technology Planning & Evaluation

It will support R&D of multimodal sources that digitally control and recognize the five senses and emotions beyond the audiovisual senses. The interface will gradually be advanced with technology that minimizes cognitive dissonance by reflecting individual sensory response deviations.

Since the metaverse is a space where multiple users are active at the same time, the technology to synchronize multiple user interactions without delay is also a technical challenge that must be overcome. As user freedom increases and the number of participants increases, for example in games and virtual concerts, the data to be processed and synchronized increases.

Technology development tasks for real-time interaction synchronization based on edge clouds will be prepared, and considering that it is an environment in which various devices and interfaces are used, standardization and standardization of interfaces will also be promoted at the same time. The future entertainment and creative industry will become more and more user-centred. The CEO of Newbase, a XR based medical education platform startup in Korea, also mentioned the importance of content. The content, conveyed by the metaverse, should achieve aesthetics, satisfaction, pleasure, or feedback to motivate users continuously.

KAIST is one of the leading universities that has focused research on real-time UI/UX and avatar based/multimodal interaction. Its Post Metaverse Research Center³², supported by MSIT, Institute of Information & communications Technology Planning & Evaluation (IITP), and Daejeon Metropolitan City, has more than 25 professors and researchers exploring into these topics.

b. Healthcare

South Korea has the best medical institutions and hospitals in Asia, with large hospitals actively developing and applying new advanced technologies including AI, robots and XR. It is also worth noting that the research community of medical applications in the country is very well-organized, with Electro-encephalography (EEG) or brain wave studies becoming the primary trend in this area.

The metaverse technologies can improve the services by offering seamless experiences to patients and enhance the work efficiency of doctors and nurses by providing XR-driven visuals and audio in their operations.

Park from NewBase mentioned training of healthcare workers and students using digital patients as potential application and R&D areas. Some companies have done projects to train the internal anatomy of the human body in digital patients and use them to simulate various symptoms of real patients before operations. In addition to the visual simulation of scenes, there is also growing research on AI technology that simulates the vocalization of a patient's voice when they are feeling unwell.

In medical applications, Professor Im from School of Biomedical Signal Processing and Neural Engineering at Hanyang University said that studies started incorporating EEG into VR devices and using it to diagnose or treat mental health and psychiatric issues. Specifically in surgeries, Professor Hong from Surgical Robotics

³² [KAIST Post Metaverse Research Center: https://meta.kaist.ac.kr/rcenter/](https://meta.kaist.ac.kr/rcenter/)

and Augmented Reality Lab at Daegu Gyeongbuk Institute of Science and Technology (DGIST) and his team have been developing 3D visualization using AR and VR technology to assist surgeons during operations.

Seoul National University (SNU) Medical Big Data Research Center is also working on the development of AR solutions for central venous tube insertion surgery and VR contents for surgical education³³. It has been developing a central venous tube implantation device using AR technology by creating virtual anatomical structures. The purpose of the study is to implement and disseminate surgical systems that increase the safety of risky surgical procedures. Additionally, for more effective education on surgical education, the researchers are developing 360 image-based surgical simulation for amniotic surgery.

Metaverse applications to healthcare does not limit to physical health but also to mental health. R&D team at Gangnam Severance Hospital has published its study on the effectiveness of showing VR contents to patients before endoscopic procedures.³⁴ Professor Park and Kim demonstrated that showing worried patients a VR screen with a calm atmosphere before the procedure showed a result of lowered anxiety and fear of those.

This study showed a potential of non-pharmaceutical tools such as VR that can reduce side effects of traditional approaches. In 2023, Korea University published a study comparing counselling outcome for college students between metaverse and in-person approaches³⁵. The study showed that the virtual counselling showed larger and quicker changes in counselees' symptoms, suggesting the metaverse counselling as an effective approach.

³³ [SNU Medical Big data Lab: https://healthbigdata.org/research/labs/?type=view&return_url=%2Fresearch%2Flabs&idx=60](https://healthbigdata.org/research/labs/?type=view&return_url=%2Fresearch%2Flabs&idx=60)

³⁴ Kim, Yuna et al. "Relieving Anxiety Through Virtual Reality Prior to Endoscopic Procedures." *Yonsei medical journal* vol. 64,2 (2023): 117-122. doi:10.3349/ymj.2022.0319

³⁵ Cho, Soohyun et al. "Comparing counseling outcome for college students: Metaverse and in-person approaches." *Psychotherapy research : journal of the Society for Psychotherapy Research*, 1-14. 17 Oct. 2023, doi:10.1080/10503307.2023.2270139



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c. **Social science and humanities**

Metaverse is a space where avatars often represent ourselves. A major focus of research and development in this field is digital human technology, which aims to make these avatars look and behave more like real people. The goal of this technology is to make avatars appear lifelike enough to avoid the "Uncanny Valley" effect, which refers to the phenomenon where the avatars look almost human-like but feel unsettling or unnatural.

The goal is to make avatars smart enough to respond naturally to their surroundings. Visually, the focus is on creating high-quality rendering technology for settings with many users. This technology will closely match real users' facial expressions with high precision (1 mm or less of error) and adapt the level of detail based on how close an object or person is. This way, avatars will look realistic and respond quickly, even when many are in the same virtual space.

In Korea, R&D regarding digital human technology will be focused in consideration of the connection with technology that authenticates the user's identity. Since economic activity in the metaverse can be formed based on trust in the other party, identity authentication of avatars representing users and technology to easily identify and verify users are essential technical elements to improve the reliability of the metaverse.

Given the side effects observed from the widespread use and success of social media platforms, numerous studies have already explored the motivations, self-identity, and social presence of metaverse users to gain a deeper understanding of their behaviours. In 2022, researchers from Jeonnam University studied on how Zepeto users perceive themselves in the platform.³⁶ Another study from Sogang University researchers in 2022 looked into the influence of Zepeto users' social- and self-presence on flow experience by their avatar types.³⁷ These studies suggest that understanding how and why users engage with these platforms is essential for creating a more inclusive, ethical, and sustainable metaverse ecosystem.

Other studies focus more on the virtual communication part. For example, a study from Kookmin University in 2023 explored the uncertainty perceived according to the purpose of communication among social interactions in the metaverse.³⁸ The study demonstrates that restricted non-verbal communication in virtual environments can amplify uncertainty in communication.

d. **Education**

Education is one of the sectors where XR technology is widely used in South Korea. It has been implemented in different level of education from elementary schools to universities, job training, and safety education. For example, 3D Tada – a software start-up – creates 3D modelling for the purpose of training creators and

³⁶ Jihye Lee, & Chungmin Joo (2022). A Study on the Perception of Self-Identity of Metaverse Users : Focusing on Symbolic Interactionist Theory. *Korean Journal of Journalism & Communication Studies*, 66(3), 92-138, 10.20879/kjics.2022.66.3.003

³⁷ Chaelin Jang, & Sooyoung Lee (2024). An Exploratory Study on the Influence of Zeppetto Users' Avatar Type, Social Presence, and Self Presence on Flow Experience. *Korean Journal of Broadcasting and Telecommunication Studies*, 38(1), 74-115, 10.22876/kab.2024.38.1.003

³⁸ Xianglian Han, & Myeongheum Yeoun (2023). Exploring the Uncertainty Perceived According to the Purpose of Communication Among Social Interactions in the Metaverse. *Archives of Design Research*, 36(2), 195-213, 10.15187/adr.2023.05.36.2.195

NewBase has developed NurseBase and MediBase which are the tools utilizing VR for immersive medical simulations.

Large number of R&D projects have been looking into the effectiveness of education and training using XR technology. The level of knowledge absorption, educational satisfaction, academic self-efficacy, academic achievement, and learning flow are the criteria that research projects investigated. For example, a study from 2023 analysed the learning effects of XR technology in university education³⁹ while another study in 2024 delved into satisfaction of remote education in metaverse platform in terms of learning environment.⁴⁰

More specific study was on legal issues on metaverse as an environment of law education⁴¹ and analysis of VR safety education for foreign construction workers in Korea.⁴² These studies demonstrate that diverse education institutes are making efforts to see if virtual education, accelerated by the pandemic, could be a more effective and long lasting education method for students. Some of these studies also suggest directions and models for these types of education and trainings, arguing that setting the right learning environment would be key to success.

³⁹ Hye-Young Park, & Jung-Hoon Joo (2023). Meta-Analysis of the Learning Effects of VR, AR, and MR Technology in University Education. *Journal of Digital Contents Society*, 24(10), 2409-2414, 10.9728/dcs.2023.24.10.2409

⁴⁰ Jiseob Park, Hyuk-Jun Kwon, & Hyeob Kim (2024). Perception and Satisfaction Study on Remote Education in the Metaverse: Focusing on the Virtual Learning Environment. *The Journal of Society for e-Business Studies*, 29(1), 1-16, 10.7838/jsebs.2024.29.1.001

⁴¹ ChoiSeongkyung (2022). Legal Issues on Metaverse as an Environment of Law Education. *Korean Lawyers Association Journal*, 71(5), 98-125.

⁴² Younghee Noh, Jong-Hwa Jang, & Ja Young Lee (2024). Analysis of Current Status of VR-based Safety Education for Foreign Construction Workers and Direction of development of Safety Education. *Journal of the Korea Academia-Industrial cooperation Society*, 25(4), 155-164, 10.5762/KAIS.2024.25.4.155

Collaboration opportunities for Denmark

As part of the ‘Pan-governmental strategic blueprint of Metaverse’ by MSIT, the government pledged to establish the so called Metaverse Convergence Graduate Schools within leading universities in Korea. The graduate school project aims to operate specialized research and curriculum development and industry-academic cooperation within the Metaverse field.

The selected universities operate multi-disciplinary courses that combines elements within digital technology, humanities and social science necessary for the implementation of Metaverse solutions. The initiative underlines the importance of education to nurture highly skilled talents, while pushing the collaboration with universities and research institutes around the world. Between 2022 and 2024, 8 universities (full list in Table 3) were selected, with a plan to choose two more schools by 2026.⁴³

The Ministry provides a total grant of KRW 5.5 billion (DKK 28.6 million) per school for six years, once it is selected. This implies that there are multiple universities to collaborate with for R&D and talent exchange in general.

Korean Universities are generally open to international student exchange programs and short-term summer schools. These initiatives can serve as a foundation for collaboration between Danish and Korean universities in Metaverse-related technologies.

There is a great appetite among Danish higher education students to study in Korea, driven largely by Korea's strengths in the creative industry. This interest can be further explored for future talent collaboration in Createch.



⁴³ [Korean Government Policy Briefing: https://www.korea.kr/briefing/pressReleaseView.do?newsId=156614109](https://www.korea.kr/briefing/pressReleaseView.do?newsId=156614109)

University	Program description
<u>Korea Advanced Institute of Science & Technology</u>	NCSOFT, KT, Naver, and other metaverse collaboration companies provide opportunities for students to learn advanced technologies through personnel exchanges such as industry-academia scholarship programs and internships.
<u>Sogang University</u>	The program aims to establish a strong industry-academia partnership to facilitate large projects, internships, and R&D collaborations. It includes PBL courses to address industry needs, evolving into advanced PIP courses, and offers micro degree training programs for professionals.
<u>Chung-Ang University</u>	The program aims to train global experts in metaverse content, offering an integrated curriculum in nine areas: scenario writing, art, webtoons, culture, studios, shopping, gaming, medical, and character development.
<u>Soongsil University</u>	The program is to nurture world-class metaverse leaders through the organic integration of technology, humanities, and design.
<u>Konkuk University</u>	All students will receive scholarships and will conduct research focused on themes that integrate metaverse spaces, experiences, and intelligence.
<u>Sungkyunkwan University</u>	The program aims to create a business-friendly, integrative education model, sending graduate students abroad for joint research. It focuses on training specialized personnel to lead global standards in all areas of the metaverse, including content planning, production, promotion and launch.
<u>Kyung Hee University</u>	In 2022, the university became the first in the country to establish a hyper-realistic metaverse studio for education and developed its own educational metaverse platform.
<u>Sejong University</u>	The curriculum is centred around metaverse projects focusing on spaces, humans, objects, and society, designed to meet the specific demands of various industries.

Table 3. List of Metaverse Graduate Schools

On a start-up level, Korea offers numerous opportunities for Danish start-ups especially in virtual training and education, digital fashion, the creative industry or health-tech solutions. With an ecosystem valued at KRW 308 trillion (DKK 1.6 trillion), Seoul ranked 9th out of 300 cities in the Global Start-up Ecosystem 2024⁴⁴ jumping from a ranking above 20th in 2019.

This leap is attributed to a vigorous fundraising environment, substantial investment in R&D, and an outstanding talent pipeline⁴⁵. Support extends beyond domestic start-ups, with government programs such as Overall Assistance for Start-up Immigration System⁴⁶ and K-Start-up Grand Challenge⁴⁷ encouraging foreign start-ups to integrate into Korea's thriving start-up ecosystem.

Particularly on health-tech solutions including XR for mental health, surgeries, and training healthcare professionals, Danish stakeholders can connect to Korean counterparts through the Danish-Korean Smart Hospital Alliance.

Facilitated by the Embassy of Denmark in Korea since 2023, the alliance aims to build a stronger network and foster knowledge exchange between key stakeholders in the health sector including hospitals, companies, and community experts from both nations. The alliance focus on activities such as delegation visits and technical seminars with the purpose of improving hospital operations with health-tech solutions and through joint R&D collaboration.



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⁴⁴ <https://startupgenome.com/ecosystems/seoul>

⁴⁵ [The Global Startup Ecosystem Report 2024: https://startupgenome.com/report/gser2024](https://startupgenome.com/report/gser2024)

⁴⁶ <http://www.oasisvisa.com/about.html>

⁴⁷ [K-STARTUP GRAND CHALLENGE 2024: https://k-startupgc.org/](https://k-startupgc.org/)

Potential funding opportunities for research and innovation collaboration can be found in the Global Innovation Network Program from the Danish Agency of Higher Education and Science, which operates one call annually⁴⁸. This program can build and strengthen contacts between Danish and Korean ecosystem stakeholders, who are looking to establish a long-term collaboration. Eligible applicants include Danish university departments, RTOs, national clusters, public hospitals (with research), other Higher Education Institutions (with research), and other government funded research institutions.

Another useful platform is the EUREKA programs, as both Korea and Denmark are EUREKA member countries. Eurostars is one such program, providing funding for SMEs looking to collaborate on R&D projects that create innovative products, processes or services for commercialisation. Through this program, Danish SMEs can collaborate with innovative SMEs, universities and research centres in Korea on metaverse-related technologies. Danish research and higher education institutions can also use this program for collaboration with some of the many Korean SMEs operating in this field.

By January 2025, Korea will be associated to Horizon Europe (pillar 2). This will open new opportunities for Danish-Korean research and innovation collaboration through the EU's funding program. One potential area to look is cluster 4 (Digital, Industry and Space), which includes open calls on emerging technologies such as XR or immersive environments. The 2023-2025 work program emphasizes personalised, innovative, efficient and inclusive learning and the development of an EU strategy and roadmap towards an open human-centric metaverse.

Specific opportunities for Danish-Korean collaboration can be discussed with Innovation Centre Denmark Seoul.

⁴⁸ <https://ufm.dk/en/research-and-innovation/funding-programmes-for-research-and-innovation/eu-and-international-funding-programmes/international-cooperation/global-international-network-programme>