Chapter 3

Realizing a Robust and Sound Data Distribution Society That Is Required for the New Age

With the advancement of telecommunications networks, the volume of data distribution has increased, and a variety of digital services utilizing data have spread throughout society. However, with regard to the distribution and utilization of data, there are concerns about a fair competitive environment due to the concentration of data on some major platform providers, the fairness and transparency in the handling of collected and accumulated data, and issues such as the spread of illegal harmful information, disinformation and misinformation, and information bias on social media and other platforms. Each country is responding to these issues.

Under such circumstances and with the realization of 5G networks that enable ultra-high-speed and large-capacity data distribution and the further advancement of XR (cross-reality) technology, AI, and other technologies, there are new movements in the concept of distribution and management of data and in services that utilize data.

This chapter provides an overview of the emerging trends in data distribution and utilization, and it analyzes and summarizes issues and initiatives for realizing a society in which everyone can enjoy the benefits of diverse digital services utilizing data.

Section 1   New Trends in Data Distribution and Utilization

This section summarizes Web3, which is attracting attention as a new trend in data management, distribution, and utilization and its applied technologies (non-fungible tokens (NFTs), etc.), metaverses and digital twins, examples of the use of generative AI, and measures taken by various countries related to these technologies and services.

1. Web3

(1) What is Web3?

The proliferation of smartphones and social media has made it possible to use and share data in both directions, but it has also led to an excessive concentration of data on platform providers that provide the infrastructure for services. Accordingly, issues such as the development of a competitive environment in the data market and the transparent and appropriate handling of data have become apparent, and a range of measures are being implemented by various countries. (See Section 2 in Chapter 2.) Under such circumstances, Web3 is attracting attention as a new way of managing and distributing data.

Web3 is a distributed network environment based on blockchain technology,[1] and it is expected that it will enable individuals to connect with other individuals without having to go through an intermediary, such as a platform provider, to perform data utilization and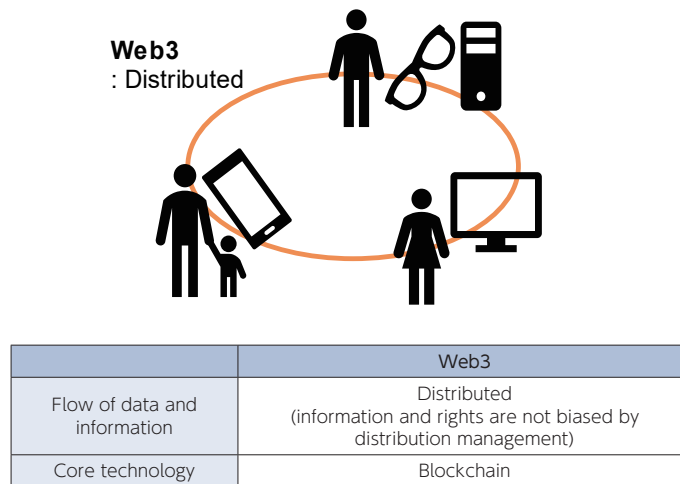 distribution management in both directions. Blockchain is used as the platform for data recording and data movement when users use internet services. Furthermore, by utilizing a smart contract, which is a program stored in a blockchain, it becomes possible to realize a mechanism that automatically executes the exchanging of a contract, etc. without human intervention.

Web3 has been described as decentralized because it creates a new digital economy in which independent users can directly connect with each other on a decentralized network that is based on blockchain without having to depend on a specific platform (**Figure 3-1-1-1**).

With Web3, the reduction in transaction costs and the capability to co-create, preserve, and exchange all kinds of value across borders and platforms is expected to have social impacts, such as building new business models in the cultural and economic fields, promoting investment and economic revitalization, and solving social issues.

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[1] In this document, Web3 is considered a different concept to Web 3.0, which is proposed as a semantic web (technology that adds meaning [semantics] to information resources so that computers can process them autonomously without human intervention).

Figure 3-1-1-1　Features of Web3

Web3
: Distributed

	Web3
Flow of data and information	Distributed (information and rights are not biased by distribution management)
Core technology	Blockchain

(Source) Based on Document 1-2 from the 1st meeting of the MIC Study Group on the Utilization of Metaverse Towards Web3 Era

(2) An example of a Web3 application

a　Non-fungible tokens (NFTs)

Non-fungible tokens (hereinafter referred to as NFTs) are unfalsifiable and tamper-proof digital data that can provide uniqueness to digital data on a blockchain to ensure its authenticity and can track transaction histories.[2] It is expected that NFTs will make it possible to prove the uniqueness and authenticity of original documents and enable designs that allow creators to earn revenue even during secondary distribution through programmability. Furthermore, initiatives for solving social problems and realizing a symbiotic society using NFTs are also underway.

For example, Social Art Lab, a general incorporated association that was established for the purpose of "creating an environment where people with disabilities can live in art," has been undertaking initiatives to convert the art of people with disabilities into NFTs so that they can be offered to a wide range of people, and it exhibits NFT art at events held at metaverse venues. It also sells art in the NFT marketplace and returns 74% of sales revenue to the artist or institution in the case of primary distribution.[3]

In August 2022, Chiba Institute of Technology began issuing academic certificates as NFTs. This is the first attempt in Japan to issue certificates as NFTs so that a person's academic history can be recorded on a blockchain, which prevents tampering. The certificate data can be managed using a virtual currency wallet, allowing users to connect to various platforms and showcase their qualifications in a one-stop shop.[4]

b　Decentralized Autonomous Organizations (DAO)

A Decentralized Autonomous Organization (hereinafter referred to as DAO) is an organization that: utilizes blockchain technology and smart contracts, does not have a centralized management structure, and aims for autonomous management by participants.[5]

Some regions are now using DAOs to revitalize their communities and solve problems. For example, the Yamakoshi DAO was established in the Yamakoshi region of Niigata Prefecture with the aim of ensuring sustainable development of the region, and it uses the art of Nishikigoi, a symbol of Yamakoshi, as an NFT. Holders of this NFT art[6] can participate in the Yamakoshi DAO, and the proceeds from sales fund its activities.

In June 2022, Shiwa Town in Iwate Prefecture announced its Furusato DAO initiative, which aims to overcome physical constraints and bring together diverse human resources to solve local issues with new ideas. Local currency (tokens) will be issued to pay hometown taxes, etc., and it is currently working on several projects.[7]

c　Trends in discussions and promotional measures in Japan and overseas

While it is expected that the Web3 environment will enable the building of new business models, revitalize investing and the economy, and promote the resolution of social issues, there is a need to collaborate globally to solve problems because the lack of an intermediary makes the location of responsibility and the targets of regulation ambiguous, and cross-border activities make it difficult to formulate rules on a country-by-country basis.

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[2] https://www.meti.go.jp/shingikai/sankoshin/shin_kijiku/pdf/004_05_00.pdf
[3] https://prtimes.jp/main/html/rd/p/000000003.000091351.html
[4] Chiba Institute of Technology Press Release https://www.it-chiba.ac.jp/media/pr20220818.pdf
[5] Digital Agency: Web 3.0 Study Group Report (December 2022) https://www.digital.go.jp/councils/web3/#report
[6] As of September 14, 2022, 996 people had purchased NFTs. Note that these NFTs are distributed free of charge to residents of the Yamakoshi region.
[7] Presentational material presented by Shiwa Town, Iwate Prefecture, at the 4th meeting of the Digital Agency's Web 3.0 Study Group https://www.digital.go.jp/assets/contents/node/basic_page/field_ref_resources/495a2882-d9e4-4f25-b75f-acc6a5f38312/644f8005/20221025_meeting_web3_outline_01.pdf

In Japan, in response to the inclusion of the development of an environment for promoting Web 3.0, including the use of non-fungible tokens (NFTs) based on blockchain technology, in the Basic Policy on Economic and Fiscal Management and Reform 2022, which was approved by the Cabinet in June 2022, and the Priority Policy Program for Realizing Digital Society, each ministry and agency is examining issues and initiatives regarding its promotion. The Digital Agency created the Web 3.0 Study Group (chaired by Professor Jiro Kokuryo of the Faculty of Policy Management, Keio University), and in December 2022, it met and summarized future initiatives for the sound development of Web 3.0.[8]

Other countries are also examining promotional policies. In March 2022, the U.S. issued an executive order to examine strategies for utilizing digital assets and the underlying technologies that form their foundation, and initiatives are underway. In November 2022, the European Parliament passed a resolution to establish Digital Decade Policy Programme 2030, which includes plans for EU countries to jointly invest in Web3 and blockchain. In July 2022, the Shanghai Municipal People's Government in China released a draft of the 14th Five-Year Plan for the development of Shanghai's digital economy. This document includes plans to build an innovation system for blockchain technology, create a blockchain development ecology, and develop infrastructure for promoting Web3.

2. Metaverses and digital twins

(1) Metaverses

a   What is metaverse?

XR (cross-reality) technologies such as virtual reality (VR), augmented reality (AR), mixed reality (MR), and substitutional reality (SR) have become more realistic due to the increasing capacity and speed of communications networks, improved computer rendering, and the evolution of devices and software (higher resolution and smaller sizes). During the COVID-19 pandemic, various economic and cultural activities were restricted, resulting in attention being focused on metaverses, where the real world and virtual space are linked and people can gather virtually from the comfort of their own homes and share the same experiences through events, etc. and transmit, experience, and share new value.

The global metaverse market is expected to grow from $65.51 billion in 2022 to $936.57 billion in 2030, and a number of companies are entering the market in anticipation of future growth.

Although a clear definition of what a metaverse is has not yet been established, a report by the Ministry of Internal Affairs and Communications[9] defines it as "a virtual digital space accessible via a network, such as the Internet, that allows users to 'communicate' with each other," with characteristics such as (1) realism and reproducibility according to the intended use,[10] (2) self-projection and immersion, (3) interactivity (often in real time), and (4) the ability for anyone to participate in the virtual world (openness).

A questionnaire survey[11] that asked consumers in various countries about their awareness of the metaverse found that approximately 60% of respondents in Japan were aware of it (the sum of "Completely aware of meaning and specifics," "Somewhat aware of the meaning and specifics," and "Heard of the term") **(Figure 3-1-2-1)**, with the highest percentage of respondents being in their 30s (68.0%). Although awareness is lower than in other countries, the term "metaverse" is becoming increasingly better known by consumers in Japan.

However, only 2.8% of respondents in Japan answered "Currently using (have used in the past)" a metaverse, so the results show that there are very few consumers who have actually used one **(Figure 3-1-2-2)**.
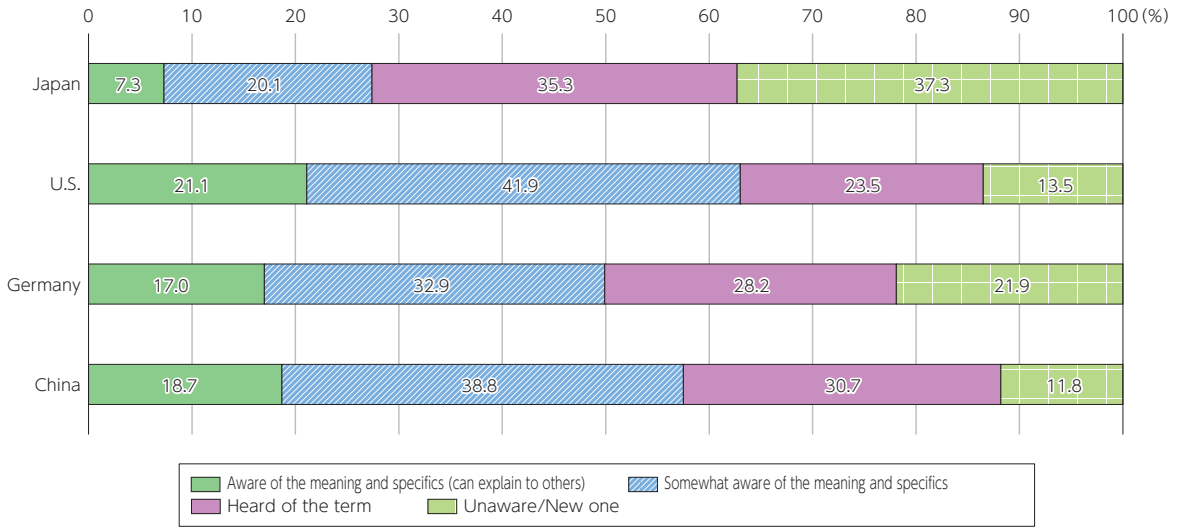
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[8] Digital Agency: Web 3.0 Study Group Report (December 2022) https://www.digital.go.jp/councils/web3/#report
[9] Interim Report of the MIC Study Group on the Utilization of Metaverse Toward the Web3 Era
   https://www.soumu.go.jp/main_content/000860618.pdf
[10] They may replicate the real world like digital twins, construct simplified models of the real world, or construct different worlds, including with respect to the laws of physics.
[11] Web survey of people living in Japan, the U.S., Germany, and China; age (20s, 30s, 40s, 50s, 60s, and over); sex (male and female); number of collected responses: 4,000 (Japan 1,000, U.S. 1,000, Germany 1,000, and China 1,000); implemented in February 2023

Figure 3-1-2-1 Awareness of metaverses by country

	Aware of the meaning and specifics	Somewhat aware	Heard of the term	Unaware/New one
Japan	7.3	20.1	35.3	37.3
U.S.	21.1	41.9	23.5	13.5
Germany	17.0	32.9	28.2	21.9
China	18.7	38.8	30.7	11.8

Legend:
- Aware of the meaning and specifics (can explain to others)
- Somewhat aware of the meaning and specifics
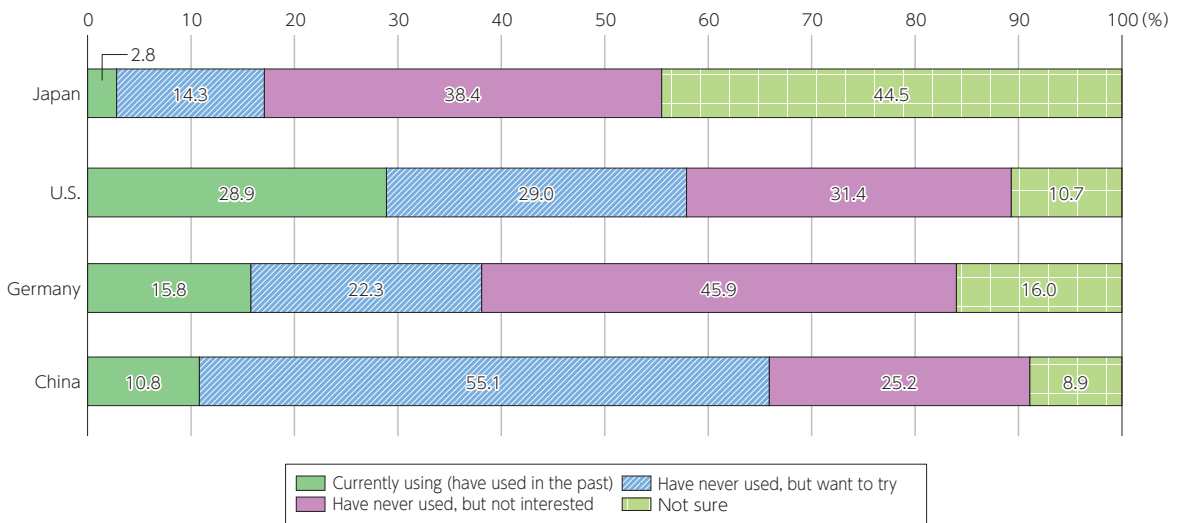- Heard of the term
- Unaware/New one

(Source) MIC (2023) "Survey Research on Advancement of ICT Infrastructure and Flow of Digital Data and Information"

Figure (related data) Awareness of metaverses by age
(Source) MIC (2023) "Survey Research on the Advancement of ICT Infrastructure and Distribution of Digital Data and Information"
URL: https://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2023/data_collection.html#f00042
(Data collection)

Figure 3-1-2-2 Experience of using a metaverse (by country)

	Currently using	Have never used, but want to try	Have never used, but not interested	Not sure
Japan	2.8	14.3	38.4	44.5
U.S.	28.9	29.0	31.4	10.7
Germany	15.8	22.3	45.9	16.0
China	10.8	55.1	25.2	8.9

Legend:
- Currently using (have used in the past)
- Have never used, but want to try
- Have never used, but not interested
- Not sure

(Source) MIC (2023) "Survey Research on Advancement of ICT Infrastructure and Flow of Digital Data and Information"

b Examples of use

Awareness of metaverses is gradually increasing in Japan, and the provision of various services in the entertainment field, such as metaverse-based music events and shopping, is progressing. In addition, attempts to utilize metaverses to provide opportunities for learning and employment in the metaverse space, as well as for community development in which real cities and virtual spaces are linked, have also begun.

(a) Entertainment (NTT QONOQ)

NTT QONOQ offers XR World, a metaverse service where users can enjoy live music, walk around as their avatars, and chat with other users in a virtual space, Matrix Stream, a live streaming service in a metaverse space, and XR City, an AR city walking app. Matrix Stream is also used to distribute virtual YouTubers (VTubers) who perform video streaming and other activities on YouTube.

(b) Education (Metaverse School of Engineering, the University of Tokyo)

The University of Tokyo established the Metaverse School of Engineering in October 2022 as a place for education in the field of engineering using digital technology to create a society where all people can acquire the latest information and practical engineering skills to realize their dreams (**Figure 3-1-2-3**).

In fiscal 2022, with the aim of providing new learning

opportunities and information on engineering careers and based on the basic concept of diversity and inclusion in the field of engineering, the University of Tokyo launched the Junior Engineering Education Program for junior and senior high school students and the Reskilling Engineering Education Program, which are aimed at providing an opportunity for adults to relearn what they know, and the programs utilize metaverses.

Figure 3-1-2-3   Metaverse School of Engineering, the University of Tokyo

(Source) The University of Tokyo

(c) Creating jobs and realizing diverse working styles (PERSOL MARKETING CO., LTD.)

PERSOL MARKETING has started a business that provides workers that operate in a metaverse. In the current labor market, it is difficult to introduce suitable jobs to those that want to work but who are elderly, or are raising children, or who have certain physical characteristics, etc. By utilizing a metaverse to transcend distance, time, and physical characteristics, PERSOL MARKETING aims to realize a society in which more people can work in metaverse-based jobs, including information and hospitality services. In December 2022, at a metaverse-based job-hunting event organized by Toyota City, people who care for family members at home, etc. were employed as the information staff for the event. Going forward, PERSOL MARKETING aims to create a place where people can work in long-lasting jobs.

(d) Regional revitalization (KDDI Corporation)

Attempts to recreate real cities as metaverses in virtual space where events can be conducted that extend urban touchpoints and the urban experience are being developed.

For example, KDDI has been working on the Shibuya Ward Official Virtual Shibuya since 2020 as part of a project started in 2019 to revitalize the attractive real city of Shibuya using technologies such as 5G and XR. Virtual Shibuya recreates the city of Shibuya in a metaverse, and various events, such as Halloween festivals and live music performances, are held there (**Figure 3-1-2-4**). In 2023, with the aim of realizing open metaverses that connect to other platforms, the company began offering services that connect metaverses to Web3, digital twins, and other services, with a focus on city-linked metaverses, such as Virtual Shibuya.

In November 2021, the company established the Virtual City Consortium to develop and implement guidelines for metaverses and city-linked metaverses. The consortium announced its Virtual City Guidelines in April, 2022. In the future, it aims to further strengthen cooperation with real cities and expand economic and residential areas.

Figure 3-1-2-4   Virtual Shibuya
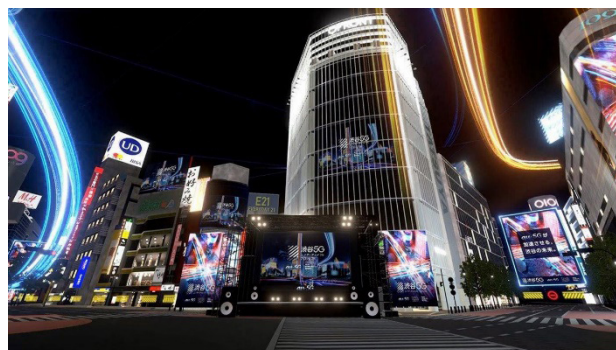
(Source) Shibuya 5G Entertainment Project

(e) Examples of uses in other countries

Uses for metaverses are advancing in a range of fields in various countries.

In the U.S., for example, VictoryXR, Inc. offers Metaversity, a platform that enables the creation of metaverse-based universities where classes are taught. As of March 2023, at least ten universities in the U.S. have adopted Metaversity, which offers classes in organic chemistry, anatomy, and physics and can display 3D models in its metaverse **(Figure 3-1-2-5)**.

As an example of regional revitalization, in October 2022, the Emirate of Sharjah in the United Arab Emirates announced plans to provide a metaverse called Sharjah Verse. The project aims to strengthen the local tourism industry and create jobs by recreating the country's tourist destinations and conducting sightseeing tours in its metaverse.

In January 2023, the city of Seoul in South Korea announced that it would launch a project called Metaverse Seoul, which recreates Seoul in a metaverse. The project is scheduled to be implemented in three stages by 2026. The first stage is to provide metaverse-based administrative services, such as the issuance of residence certificates and tax counseling. The second stage is to promote the development of the city by providing services related to real estate investment, and the third stage is to utilize AR technology for infrastructure management in Seoul City **(Figure 3-1-2-6)**.

Figure 3-1-2-5 Metaversity (U.S.)

Real university

Metaverse-based university
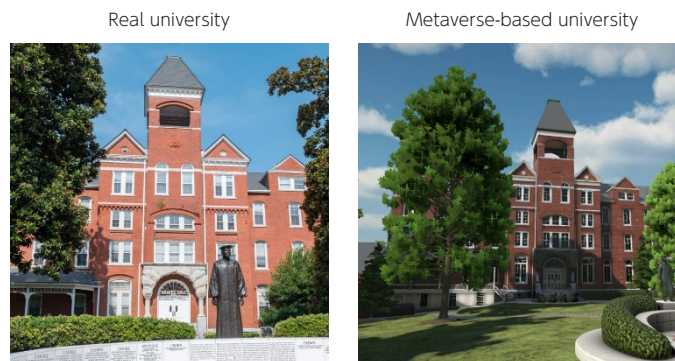
(Source) Publicly available information provided by VictoryXR, Inc. and others

Figure 3-1-2-6 Metaverse Seoul (Korea)

(Source) Publicly available information provided by Seoul City and others

c   Controversies surrounding metaverses

As metaverses are starting to be utilized, issues regarding their popularization are also being discussed.

In the current metaverse market, there are many domestic and foreign platform providers. The creators of these metaverse "worlds"[12] mainly identify target users, select a platform, and build a world on the platform. Also, platform providers sometimes create their own metaverse worlds.[13] However, there is no compatibility or interoperability between worlds, especially between worlds that exist on different platforms, and rules for generating identities and avatars, including prohibited acts and data handling that are applied within a particular metaverse, vary according to the rules set by each operator. Therefore, if data formats and data exchange formats differ between platforms, it may not be possible to carry data over from one metaverse to another on a different platform.

Going forward, as metaverses proliferate in Japan and overseas and as metaverses become new living spaces

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[12] Each metaverse world is built and operated on a platform. https://www.soumu.go.jp/main_content/000860618.pdf
[13] Interim Report of the MIC Study Group on the Utilization of Metaverse Toward the Web3 Era https://www.soumu.go.jp/main_content/000860618.pdf

for users, it is important to have an environment that allows users to freely move between various platforms while retaining avatars and items, etc. that indicate their identity. For this reason, standardization efforts to ensure interoperability in which standards for multiple platforms are shared for user convenience have begun.

In a metaverse, as in the real world, problems such as an avatar's behavior, including obscene language, discriminatory language, slander, threats, and molestation or physical actions, including harassment and violence such as stalking and voyeurism, fraudulent transactions and impersonation as well as the problem of protecting the privacy of persons controlling avatars may arise across national borders. In the process of expanding the use of metaverses in all fields, consideration is now being given on how to form rules in the metaverse space, including from the viewpoint of whether existing laws can be applied.[14]

d   Promotional measures for metaverses in Japan and overseas

Countries are now working on initiatives to promote metaverses and digital twins.

In Japan, the Basic Policy on Economic and Fiscal Management and Reform 2022,[15] approved by the Cabinet in June 2022, mentioned the expansion of the use of content including metaverses, and the Intellectual Property Promotion Plan 2022,[16] released in the same month, identified legal issues related to content on metaverses and clarified issues. In addition, the Study Group on the Utilization of Metaverse Toward the Web3 Era has been held at the Ministry of Internal Affairs and Communications to examine issues related to the utilization of metaverses, etc. in mainly the information and communications field.[17]

Looking at other regions, the U.S. and the EU have released reports on priority issues and policy issues to be discussed to promote the use of metaverses. In addition, Korea is actively developing metaverses as the new industry after smartphones, and in January 2022, the Ministry of Science and ICT announced the Korea Metaverse New Business Leading Strategy **(Figure 3-1-2-7)**.

Figure 3-1-2-7   Promotion measures for metaverses in other countries

Country	Overview, etc.
U.S.	In August 2022, the Congressional Research Service released a report titled "The Metaverse: Concepts and Issues for Congress" that summarizes the policy issues that should be considered by Congress, such as metaverse technologies and concepts. The report lists issues such as the appropriate use of content, the protection of personal information such as biometric information, the domination of platforms by major companies, and the disparity between those who have access to high-speed communications environments and those who do not.
EU	In March 2023, a policy paper title "Metaverse - Virtual World, Real Challenges" was published. The report provides an overview of metaverses (definition, history of metaverses, future fields of application, development time span, elements and related technologies, countries and companies considered to play a major role) and summarizes potential challenges and opportunities in the EU (why and how the EU should engage with metaverses).
South Korea	In January 2022, the Ministry of Science and ICT published the Korea Metaverse New Business Leading Strategy. In line with the development of metaverses, the strategy states that the Korean government will take measures such as the development of a sustainable metaverse ecosystem based on public-private cooperation, human resource development, development of industry-leading companies, and the establishment of sound and exemplary infrastructure, as well as undertake initiatives to support platform development, develop practical human resources, establish funds, and develop rules, etc.
China	In July 2022, the Shanghai Municipal People's Government in China released its 14th Five-Year Plan for the development of Shanghai's digital economy. In the metaverse field, the plan states that virtual reality technologies will be enhanced, platforms will be developed, and new digital entertainment such as virtual concerts will be fostered.

(Source) Based on Document 7-2 from the 7th meeting of the MIC Study Group on the Utilization of Metaverse Towards Web3 Era

(2) Digital twins
a   What is "digital twin"?

A digital twin is where a real space is recreated in a virtual space, based on data collected from the real world and after performing various simulations.

While metaverses and digital twins are both virtual spaces, compared with metaverses, where it does not matter whether the worlds created in such spaces are real or not, digital twins are positioned as a solution for performing simulations. Therefore, they must reproduce the real world. Also, while metaverses are often used for communicating through avatars and playing games in spaces that are not real, digital twins are often used to perform simulations that are difficult to perform in the real world.

By reproducing cities, cars, people, products, and devices in a digital twin, tests that are difficult to repeatedly perform in real spaces, such as traffic congestion predictions, human behavior simulations, manufacturing site monitoring, and durability tests, can be simulated repeatedly in a virtual space. This can provide the following benefits:

○**Optimize production and improve operational efficiency:** Optimization can be performed by optimizing the placement of devices and personnel, and

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[14] https://www.kantei.go.jp/jp/singi/titeki2/kanmin_renkei/dai3bunkakai/dai1/gijisidai.html
[15] Approved by the Cabinet on June 7, 2022 https://www5.cao.go.jp/keizai-shimon/kaigi/cabinet/honebuto/2022/2022_basicpolicies_ja.pdf
[16] https://www.kantei.go.jp/jp/singi/titeki2/220603/siryou2.pdf
[17] https://www.soumu.go.jp/main_sosiki/kenkyu/metaverse/index.html
  For details on this study group, see Section 6, Promotion of ICT utilization in Chapter 5 of Part 2

processes can be improved to shorten lead times. In addition, the results can be visually confirmed by simulations in a virtual space, thereby contributing to improving safety and reducing risks.

○**Reduce time and costs:** Compared to physically testing and prototyping, simulations can be performed easily in a virtual space, significantly reducing the time spent on physical testing.

○**Perform simulations that are not possible in the real world:** Phenomena that do not occur often in the real world can be easily generated and used to prepare for the future, such as major earthquakes and other events.

b   Examples of uses

The use of digital twins began mainly with manufacturers, such as in the aviation industry and for manufacturing lines in general, but they are now used in a wide range of fields, including national and urban planning and disaster prevention.

As an example of their use in urban planning, since fiscal 2020, the Ministry of Land, Infrastructure, Trans-port and Tourism has been promoting the PLATEAU project,[18] which develops, utilizes, and creates open data for 3D city models. Up to August 2021, it had completed open data conversion of 3D city models of 56 cities nationwide. In order to promote the digital transformation of town planning, digital twins of real cities have been constructed and released as open data, enabling anyone to freely utilize this data.

In the field of disaster prevention, since 2019, Shizuoka Prefecture has been working on the VIRTUAL SHIZUOKA project in which the topography and buildings throughout the prefecture are acquired as three-dimensional information called point cloud data, which is also being released as open data. Information, including VIRTUAL SHIZUOKA information and aerial photographs taken in the past, was compared with data measured in 3D by drones, etc. at the locations where landslides occurred. It was then analyzed and utilized for the landslide disaster that occurred in Atami City, Shizuoka Prefecture, in July 2021 to grasp the damage situation as early as possible and to prevent secondary disasters (**Figure 3-1-2-8**).

Figure 3-1-2-8   VIRTUAL SHIZUOKA

(Source) Shizuoka Prefecture

In the field of agriculture, initiatives for realizing agricultural platforms using digital twins are underway. Happy Quality Co., Ltd. offers a digital twin virtual platform that reproduces the cultivation environment in a virtual space, and it can be customized for individual farms. Utilizing this platform makes it possible to perform a range of monitoring activities and simulations. It is expected that smart agriculture will be realized through simulations of cultivation environments and remote cultivation guidance, enabling the agricultural industry to solve the problem of future labor shortages.

Outside Japan, digital twins are being used in various fields, including infrastructure management and urban planning.

For example, Oak Ridge National Laboratory and Pacific Northwest National Laboratory in the U.S. are working to develop an open platform for hydropower systems using digital twins. Monitoring an actual facility and comparing it to a digital twin will enable robust control and optimization of the facility, which is expected to reduce operating costs, improve reliability, and address increased operational complexity. Oak Ridge National Laboratory has also created digital twins for 129 million buildings across the United States, providing power companies and businesses with a way to make simulation-based decisions about how best to improve energy efficiency (**Figure 3-1-2-9**).

[18] https://www.mlit.go.jp/plateau/

Figure 3-1-2-9 Digital twin for hydroelectric systems (U.S.)
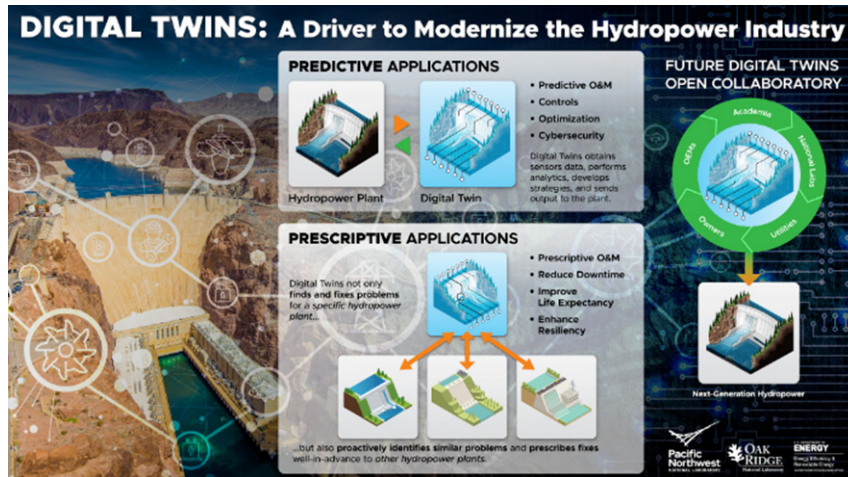
Shanghai is also using digital twin technology to run and manage the city.[19] It has developed a digital platform that reflects actual objects and information about the objects, such as buildings, street lamps, pipes, plants, etc., and it has demonstrated efficiency for managing social issues, such as garbage disposal and electric bicycle charging. During the COVID-19 pandemic, it was used for pandemic control and prevention, including providing accurate information on nearby residents to local centers for disease control and for future epidemiological studies.

3. Generative AI

(1) Generative AI trends

AI can analyze a massive amount of data to detect signs of failure or scam/spam information, to predict the future, or even to determine which video to show a website visitor next. AI that is used for data analysis is called analytical AI. This type of AI is already used widely throughout society.

However, a new type of AI called generative AI has made rapid progress recently. This type of AI is used to generate and create information—something that has conventionally been seen as a human specialty.

Open AI released GPT-3, a large language model that uses 175 billion parameters, in May 2020. The company followed this up with ChatGPT, a dialog-based AI chatbot based on GPT-3.5, in November 2022 and then GPT-4 in March 2023.

In the same month the following also happened: Microsoft announced that it would include AI based on GPT-4 in its search engine Bing and its internet browser Edge.[20] Google released Bard, an experimental dialog-based AI service using LaMDA (Language Model for Dialogue Applications) for public use, and Baidu, a Chinese search engine, released Ernie Bot, a dialog-based AI service similar to ChatGPT.

There have been developments in Japan as well. LINE Corporation and Naver Corporation collaborated to develop HyperCLOVA, a large language model (LLM) for the Japanese language. HyperCLOVA does not use a chat-based interface, but it can be used to create or summarize text. On April 1, 2023, Works Mobile Japan integrated with and absorbed LINE CLOVA (LINE's AI business that is responsible for HyperCLOVA). The company is now looking into using HyperCLOVA to provide support functions on its LINE WORKS service.[21]

2022 saw the introduction of prompt-based image-generation AI (also called text-to-image) in which users enter text to generate images. This makes it possible for AI to draw images similar to those that humans draw. Operating this technology initially required a high-performance PC capable of processing advanced calculations and storing a large amount of data. However, volunteers began developing applications that could be run on websites, allowing anyone to easily provide prompts for AI to create images.

Generative AI is now available for use in many other applications. For example, AI can be used to provide answers or summarize text in response to typed questions, create source code for programs in response to prompts from the user, or even create music from text prompts.

According to SEQUOIA and GPT-3's "Prediction of Generative AI Deployment by the 2030s" published in September 2022, it is expected that the use of generative AI will continue to make progress in the order of text, coding, image, and video/3D/game fields.[22]

The global market for generative AI is expected to expand to approximately 14 trillion yen by 2030, with a compound annual growth rate (CAGR) of 35.6% from 2022 to 2030[23] (**Figure 3-1-3-1**). North America has the largest share of the market (40.2%), based on 2021 data.

[19] https://english.shanghai.gov.cn/nw48081/20220216/d4de492067ca497991823b9758001192.html
[20] https://blogs.bing.com/search/march_2023/Confirmed-the-new-Bing-runs-on-OpenAI's-GPT-4
[21] On April 1, 2023, Works Mobile Japan integrated with and absorbed LINE CLOVA (LINE's AI business that is responsible for HyperCLOVA). The company is now looking into using HyperCLOVA to provide support functions on its LINE WORKS service.
[22] Source: https://www.sequoiacap.com/article/generative-ai-a-creative-new-world/
[23] Based on predictions by the research firm Grand View Research, Inc. (at a conversion rate of 1 USD = 130.3715 JPY as of Jan. 25, 2023)

Figure 3-1-3-1　Global market size of generative AI

(Trillion yen)

CAGR : 35.6%

2022: 1.2
2030: 14.2
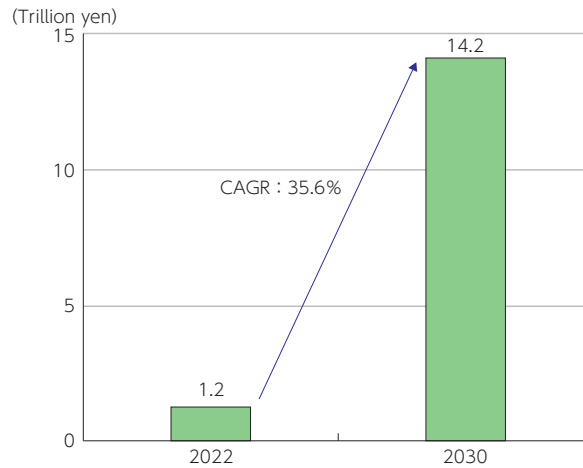
(Source) Survey by Grand View Research Inc.

(2) Controversies regarding generative AI

While the use of generative AI has been spreading all over the world, some issues with the technology have been raised, for example, the handling of confidential information, personal information protection, and the accuracy of answers it provides.

As discussed in more detail in Section 3 of Chapter 2, generative AI also has the possibility for misuse. It can be used to create fake images or videos that if spread, either intentionally or unintentionally, could infringe the rights of others or even cause social turmoil. For example, a prompt-based image-generation AI called Stable Diffusion was used in September 2022 to create fake images of flooding in Shizuoka Prefecture in Japan. These images were then spread through social media. Investigations revealed that it took only 14 seconds to create the images.[24] It is now possible for anyone to use image-generation AI to easily create and spread fake images of very high quality.

The technology can also be used to infringe upon intellectual property rights, which could have a negative economic impact on artists, illustrators, and other content creators. In January 2023, a number of artists in San Francisco sued two companies developing image-generation AI technology (Stability AI Ltd, Midjourney Inc. and DeviantArt, Inc.), claiming copyright infringement. The plaintiffs claimed that the companies had created copies of artwork protected under copyright and generated images mimicking the styles of millions of artists, infringing the rights of those artists. They requested monetary damages and a court order as a means to prevent copyright infringement by AI companies. In Japan, a company called RADIUS5 released "mimic," an AI trained on human-generated images that was capable of automatically generating images mimicking the style of the original artist. However, the service was terminated after only one day due to the many concerns voiced over the possibility of the technology being misused.

Although companies providing AI services have established rules for using their technologies, these companies must do more to ensure that users are made aware of their rules. Users must also strive to use these technologies in an ethical manner.

The use of generative AI is already being discussed at both national and international levels.

In March 2023, the Italian Data Protection Authority[25] temporarily prohibited the use of ChatGPT, claiming that sufficient information was not provided to data owners, that the company had a legal obligation to justify its collecting and processing of large volumes of personal data for machine learning, and that the mechanism in place for verifying the age of users was insufficient. In April of the same year, authorities in the UK[26] released eight points of consideration in developing and using generative AI that makes use of personal data, such as the requirement to clarify the legal basis of such technologies, the obligations of organizations managing the data, and the need to perform risk assessment. In the U.S., the National Telecommunications and Information Administration (NTIA) sent out a request for comments on the topic of a system for auditing, evaluating, and certifying AI.[27] Finally, in May of the same year, the Biden administration announced a new policy for promoting responsible AI innovation,[28] consisting of guidelines for investing in responsible artificial intelligence (AI) research and development, evaluating generative AI developed by private companies, and the use of AI by the federal government in order to stress the fact that companies are responsible for confirming safety prior to

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[24] https://spectee.co.jp/report/202209_shizuoka_typhoon15_fake/
[25] Garante per la protezione dei dati personali
[26] Information provided by the Commissioner's Office
[27] https://ntia.gov/issues/artificial-intelligence/request-for-comments
[28] https://www.jetro.go.jp/biznews/2023/05/7c5bc3a8bf11f2ff.html

developing and releasing AI products.

In the EU, a decision was reached to establish a task force to investigate concerns over privacy protection with regard to ChatGPT.[29]

Cooperation between countries has also seen some progress in this area. During the G7 Digital and Tech Ministers' Meeting held in Takasaki, Gunma Prefecture, in April 2023, participants discussed the topic "Responsible AI and Promoting of AI Governance" and adopted "The G7 Digital and Tech Ministers' Declaration"[30] in which a decision was reached to convene for discussions on generative AI and to create an action plan for the promotion of global interoperability of AI governance as soon as possible.

During the G7 Summit held in Hiroshima in May2023, participants expressed a common understanding of the importance of engaging in international discussions on the topic of AI governance at the top level, as well as the importance of ensuring the interoperability of AI governance. Participants also agreed to establish the Hiroshima AI Process by the end of the year to discuss generative AI.[31]

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[29] https://edpb.europa.eu/news/news/2023/edpb-resolves-dispute-transfers-meta-and-creates-task-force-chat-gpt_en
[30] https://www.soumu.go.jp/main_content/000879099.pdf
[31] https://www.mofa.go.jp/mofaj/files/100506875.pdf