

Analysis of Strategies with Respect to Virtual Worlds and Standardisation



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1 Scope

This report offers a comparative analysis of virtual world and metaverse strategies across major global regions, including the European Union, China, Japan, South Korea, and the United States. It examines varying national priorities, governance models, and approaches to standardization, highlighting how each region aligns its immersive technology ambitions with broader economic and political goals.

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3 Introduction

As described in the virtual world Standards Landscape report, published by ETSI as part of the ViWISSO project [i.1], standardization is an important approach to reducing the negative impacts and risks of over-reliance on proprietary virtual world technologies. While the development and adoption of interoperability standards for virtual world innovation and economic development is needed and has received considerable attention over the past decade, the approach is most effective when done in the context of a broader strategic roadmap, and aligned or enforced with regulations and legal frameworks.

This report examines and positions the EU in the global virtual world context by comparing EC's current virtual world strategy with that of other countries. Then, the report examines the EC's standardization goals and programs. Finally, the strategies are compared.

4 Positioning the EU virtual world strategy in context

4.1 Introduction

In this chapter the strategies published by the European Commission on virtual worlds and standardization as of June 2025 are compared and contrasted with current policies on virtual worlds and standardization in other geographic regions. First, in this introductory clause, the EC's current positions and objectives with respect to virtual worlds as reflected in multiple publications, are summarized in order to provide the context for the analyses that follow.

The Single Market is one of the EU's key assets and an important driver of its competitiveness. In 2023, in an announcement of its 2030 roadmap, issued on the 30th anniversary of establishment of the Single Market, the Commission said that it would continue to focus on the enforcement of Single Market rules, to remove member-state barriers to the cross-border provision of services, to invest in the industrial ecosystems with the greatest economic integration potential (retail, construction, tourism, business services and renewable energy sector), and drive progress through nine interlocking drivers. Digitalisation is one of the key drivers identified specifically for its contribution to the technological transitions that will deliver Web 4.0 and a seamlessly interconnected, intelligent and immersive world. In July 2023, the European Union announced [i.2] that it had adopted a new strategy to steer the technological transition to Web 4.0 and virtual worlds. Published in November 2023, the Communication entitled "An EU initiative on Web 4.0 and virtual worlds: a head start in the next technological transition" [i.3] laid out ten specific actions that the Commission will initiate, signalling a proactive approach to positioning Europe at the forefront of the next technological transition. Accompanying the Communication above were two publications that provided further context and insights: a staff working document that delves into the issues and the Commission's vision for virtual worlds, and a report presenting the results of a Citizens Panel dedicated to exploring this topic [i.4]. These foundational documents establish the initial framework and priorities, against which subsequent publications and policy developments must be evaluated to compare the European Commission's stance on virtual worlds with that of other regions.

The initial strategic priorities provided in the November 2023 communication have been followed by more specific considerations across various sectors, including citizen engagement, industry trends, competition policy, child safety, industrial applications, and creative industries. The explicit inclusion of support for virtual world development within the 2025 Annual Work Programme for the Creative Europe Programme demonstrates the European Commission's intention to foster innovation and artistic expression within these digital environments [i.5]. This initiative acknowledges the growing convergence between creative industries and immersive technologies, potentially leading to new forms of cultural experiences and economic opportunities for European creators.

In May 2024, the European Blockchain Observatory and Forum, published a report [i.6] that explores the evolving landscape of virtual worlds and their connection to Web 4.0. It defines key terms, outlines the EU's strategic pillars for this technological transition, and emphasizes the crucial role of blockchain technology in building secure and interoperable virtual environments. The report also discusses potential future trends and diverse use cases for secure transactions and experiences across different sectors.

The European Commission's Competition Policy Brief September 2024 issue focuses on competition in generative AI and virtual worlds [i.7]. It highlights the European Commission's proactive stance on regulating the competitive environment of these emerging technologies. By addressing potential competition concerns at a relatively early stage of development, the Commission aims to prevent market distortions and ensure a level playing field for innovation and the benefit of both consumers and businesses in the long term. This forward-thinking regulatory approach is consistent with the EU's broader objectives of fostering a competitive and fair digital economy.

Finally, the inclusion of virtual world-related concepts within the Industry 5.0 Community of Practice Pilot Phase Final Report [i.8] explores the use of virtual twins and immersive technologies within the context of Industry 5.0, demonstrating a vision where virtual worlds contribute to enhancing the competitiveness and sustainability of European industry.

The progression of publications cited above indicates the evolution of the European Union's understanding and engagement with the multifaceted nature of virtual worlds. Through these and other activities, the European Union continues to focus on balancing the potential benefits of virtual worlds with the need to address societal and economic challenges. The emphasis on citizen well-being, ethical development, and fostering a competitive and innovative European ecosystem are central to the Commission's approach.

As made clear by the present research project, future areas of focus for the European Commission in this domain include the development of interoperability standards to ensure seamless transitions between different virtual environments, the establishment of clear governance frameworks to address legal and ethical considerations, and the promotion of international cooperation to align global approaches to this rapidly evolving technology.

4.2 Virtual world strategies

4.2.1 Introduction

This clause summarizes the virtual world strategies of several countries, the European Union and the Land of Baden-Württemberg in Germany. The goal of the clause is to showcase the strategies of other regions that have explicitly promoted their intention to invest as well as to examine their approaches to support virtual worlds development through financial support, showcases and testbeds or regulations, or a combination of those. It also examines the United States government's current position with respect to the development of virtual world technologies. Most of the virtual world strategies outlined below are coordinated by governments, but some also involve contributions from industry consortia.

This research could be expanded to include more countries and geographies. The Italian Ministry of Business released a document describing how the Directorate General of New Enabling Technologies plans to expand its role in virtual world technologies, [i.9] however, reviewers of the document suggest that it is not a mature strategic plan. In a related and relevant development, in May 2025, the African ICT Committee published its establishment of a joint project with the Metaverse Institute to develop its strategies for virtual worlds on the African continent. The partnership commits both organizations to establish an African virtual worlds governance and adoption framework and provides for cooperation on capacity-building and joint project oversight.

Those strategic plans selected for consideration in this clause are considered the most mature, in terms of their directions, and important either economically or in terms of size. While the information about some of the programs is dated (not updated in 2024 or 2025), they serve to illustrate the range of strategies regions or countries have defined to date. It sets the stage for the next clause (4.2.3) in which the European Commission's strategies (above) are compared with those of other countries and regions.

4.2.2 Baden-Württemberg / Germany

Baden-Württemberg is positioning itself as one of Germany's pioneers in the strategic development of virtual worlds. With the release of its 2024 white paper, "Metaverse Ecosystem Baden-Württemberg: CyberLÄND," the state articulates for the first time a politically endorsed vision for immersive technologies within a federal framework [i.10]. The strategy is embedded within the region's broader digitalization agenda and is being advanced jointly by the Ministry of Economic Affairs, Labour and Tourism and the Ministry of Science, Research and the Arts. At its core lies the objective of enhancing the state's competitiveness and innovative capacity through the structured expansion of extended reality (XR) technologies in the context of virtual worlds.

The strategy takes a multidimensional approach that considers technological infrastructure, economic value creation, regulatory design, and societal acceptance. Baden-Württemberg does not treat virtual worlds as isolated innovations but as core components of future platform economies and digital sovereignty. The focus lies particularly on the interface between physical production and virtual augmentation—such as industrial digital twins, immersive training formats, and simulation-driven design and manufacturing. The region's existing strengths in high-tech industries, the automotive sector, and academic XR research are to be strategically leveraged to build an internationally visible innovation ecosystem.

Substantively, the strategy is guided by four principles. First, it aims to introduce SMEs, industry players, and the creative sector to immersive technologies and support their specific use cases through funding programs and networking platforms. Second, the state intends to play an active role in shaping open XR standards, particularly regarding interoperability, data portability, and secure identity management. Third, legal and ethical issues are being addressed, including the protection of personal data, liability in immersive environments, and the fairness of algorithmic systems. Fourth, the development of immersive educational and cultural formats is encouraged to promote participation and media literacy in virtual spaces.

To implement these guiding principles, a set of concrete measures has been defined. The "Digital Hub Extended Reality" initiative is establishing a statewide competence network that supports businesses, academic institutions, and public-sector actors in adopting immersive technologies. Funding programs such as "XR Innovation in SMEs" and "Artistic-Immersive Forms of Expression" specifically target economic and cultural innovation potential. In collaboration with the Virtual Dimension Center (VDC) and Fraunhofer IAO, testbeds are being created for standardized XR platforms. At the same time, the state is developing political recommendations to help shape XR-relevant norms and certification frameworks. An interdepartmental steering group coordinates the ongoing development and international alignment of the strategy.

Unlike national strategies, Baden-Württemberg sees itself as an "enabling region" that creates agile experimental spaces and operationalizes European regulations in practical terms. The state aims to combine economic resilience with digital self-determination and to create a competitive, value-driven infrastructure for the emerging metaverse. The strategy explicitly emphasizes the importance of open source technologies, open standards, and interoperable identities as a means of avoiding technological dependencies and safeguarding diversity in the digital realm.

With its metaverse strategy, Baden-Württemberg provides a framework that links regional strengths with global challenges. In a technology landscape marked by increasing fragmentation, the state positions itself as a European leader in immersive technology development—systematically connecting economic progress, social participation, and digital sovereignty.

4.2.3 China

Similar to the European Commission's positioning, China has a strong vision for and commitment to the development of virtual worlds. Its ambition is not just to participate in the global virtual world landscape and have an industrial base within the country but to become a leading global force, particularly in the industrial domain. In 2023, the Chinese Ministry of Industry and Information Technology (MIIT) released a comprehensive three-year action plan (2023-2025) developed in conjunction with several ministries and government agencies [i.11]. The plan focuses on development of the "industrial metaverse" and fostering the growth of influential companies and specialized industrial hubs. It is unclear how much of the original plan has been achieved to date. However, it is evident from the number of companies designing and offering wearable displays for VR and AR at international trade fairs that Chinese manufacturers are focusing attention on providing economically viable solutions to meet the

requirements of the hardware segment of virtual world technologies. At this time, China is focusing more resources on the hardware segment than any other country.

Use of virtual world technologies in other industries in China are also garnering support. Developing immersive and interactive consumer solutions, publishing digital cultural tourism experiences, and integrating VR into education and entertainment are promoted through programs supported by the central government. Museums and tourist attractions are encouraged to offer immersive experiences using virtual worlds.

While encouraging virtual world technological development and usage in China and globally, the government also appears keen to ensure that the developments in this area align with its social and political values. The fact that it has banned the use of cryptocurrencies within virtual worlds while promoting use blockchain technology elsewhere exemplifies this tension. Separately, China Mobile has submitted its proposed “Digital Identity System” to the International Telecommunication Union (ITU) for consideration. This is an example of how leading Chinese companies seek to influence global virtual world adoption and access, most likely with the central government’s support. While concerns have been raised about its potential implications for user privacy and freedom, this initiative illustrates the Chinese government’s desire to establish a regulated framework for virtual world users.

In addition to the national strategy published by the MIIT, Shanghai and Beijing also introduced their own detailed plans for development of virtual world technologies. Shanghai officials announced that they would build a \$52 billion metaverse industry by 2025, concentrating on technological breakthroughs and the emergence of key companies. Beijing’s plan emphasizes use of virtual worlds to support development of education and tourism. These regional initiatives, alongside the national plan, demonstrate a multi-layered approach to fostering the virtual world ecosystem across China.

4.2.4 Dubai / United Arab Emirates

The United Arab Emirates (UAE), particularly through the Emirate of Dubai, has demonstrated a strong commitment to becoming a global leader in the development and adoption of virtual world technologies. This ambition is evident in the Dubai Metaverse Strategy, a comprehensive framework launched to diversify the economy, foster innovation, create employment opportunities, and establish Dubai as a preeminent hub for virtual world businesses. The strategy is supported by a series of key initiatives and programs, including the Dubai Metaverse Assembly, the Dubai International Financial Centre’s Metaverse Platform and Accelerator Programme, and the establishment of a virtual world presence by government entities like the Ministry of Economy [i.12].

The goals of these programs include the creation of more than 40,000 jobs by the year 2030. The approach encompasses various sectors, leveraging virtual world technologies to transform tourism, education, retail, government services, real estate, smart city development, and healthcare. Underpinning these initiatives is an already robust technological infrastructure, with a strong emphasis on advanced 5G networks and the integration of blockchain and Web3 technologies. The focus on blockchain and Web3 is to facilitate safe and transparent transactions within virtual worlds and to establish clear ownership of digital assets. This integration is seen as essential for fostering a decentralized and user-centric virtual world ecosystem. Initiatives like the Hub71+ Digital Assets Ecosystem in Abu Dhabi, with a USD 2 billion commitment, specifically support Web3 startups, virtual world projects, and blockchain-based businesses.

As part of the implementation of its strategy, Dubai established the Metaverse Alliance in 2023, a global network including government entities, international technology companies, entrepreneurs and start-ups specialised in virtual worlds. The Alliance promotes collaborations and partnerships for both global and national projects that are centered around, or incorporate, virtual worlds or interactions. It identifies suitable partners among global technology companies, start-ups and talented individuals. It is also delivering global technological solutions for local projects with the goal of enhancing existing government services, introducing innovative government services, and establishing an enabling environment for new and innovative technologies.

Another program under the framework is the Metaverse Guidelines project. Although very little is publicly available (in English) or recently published about the project, a summary says that it identifies the most impactful virtual world use cases and provides guidance for Dubai government entities to regulate and define the optimal uses of virtual world in government work.

Finally, with the Metaverse Pioneers, another program that is not well-documented and may be out of date, the government of Dubai seeks to train and empower its employees with the essential skills and tools to harness the potential of virtual world technology in their professional capacities.

The UAE government also seeks to proactively address the regulatory landscape to ensure a safe, secure, and innovative virtual world ecosystem. The Responsible Metaverse Self-Governance Framework [i.12], published in December 2023, describes nine principles that may be built upon further with internal regulation and international cooperation. These nine principles are provided in table 1. For the framework to be effective and enforceable, the government acknowledges the need for proactive collaboration between governments, industry and other stakeholders.

Table 1. Principles of the Responsible Virtual world Self-Governance Framework

Principle	Objective
Interoperability for Access	To allow users to be able to transport their data, digital assets and identities across platforms, regardless technical, jurisdictional or geographical barriers that may exist.
Privacy by Design and Default	To ensure that users' rights and personal data are protected and respected at each stage of the data lifecycle as the virtual world expands and operates.
Sustainability by Design	To ensure that sustainability (energy efficiency) is integrated into the design of the virtual worlds, right from the start.
Reciprocity	To promote trust and fairness by creating a culture where users and stakeholders are more likely to cooperate with each other, share resources and ideas, and work towards a common goal.
Transparency for Trust	To encourage the development of products and services that are designed with user experience and expectations in mind, and that are transparent about their workings, user rights, and data collection practices.
Fairness, Equality and Inclusiveness	To ensure that all individuals have an equal opportunity to operate in the virtual worlds and there are no barriers for their entry into virtual worlds.
Commitment to Diversity	To ensure that virtual worlds are inclusive and represent the diversity of the real world.
Accountability	To ensure responsibility and accountability for virtual world systems, technologies and their outcomes including being accountable for any harm.
Safety by Design and Beneficence	To ensure that users are protected from harm, and that the virtual world is a safe and positive space for everyone

Furthermore, the establishment in Dubai of the Virtual Assets Regulatory Authority (VARA), the world's first independent regulator for virtual assets, underscores the government's commitment to creating a legal framework that encourages innovation while ensuring consumer protection and data privacy. VARA's mandate includes licensing and regulating the virtual asset sector within the Emirate, excluding the Dubai International Financial Centre, and aims to foster economic independence, responsible participation, and progressive innovation in this space. The Dubai International Financial Centre itself is also developing its own virtual world guidelines in consultation with the UAE's Central Bank and VARA, focusing on areas such as data protection, digital identity, and company law frameworks within virtual worlds.

4.2.5 European Union

The European Commission's strategy for Web 4.0 and virtual worlds was adopted on July 11, 2023 [i.2]. This strategy outlines the EU's ambition to ensure that immersive virtual environments remain open, secure, trustworthy, fair, and inclusive. By trading the term "metaverse" for "virtual worlds," the Commission emphasizes a balanced

and values-driven approach to Web 4.0, a new stage of internet evolution with advanced XR integration, AI, Internet of Things, and blockchain components

At its core, the strategy rests on four interlinked pillars. The first pillar, “Empowering people and reinforcing skills,” targets the development of digital literacy and awareness. It creates a virtual-worlds toolbox for downloading reliable information, enlists citizens’ inputs, and fosters specialist talent through funding programs such as Digital Europe and Creative Europe. The second pillar, “Supporting business,” aims to catalyze a European industrial ecosystem. By addressing fragmentation, the Commission seeks to channel public investments into innovative partnerships, using the Horizon Europe framework and new European Partnerships to bridge the gap between XR developers and industry users. The third pillar, “Government and public services,” reflects a vision where virtual worlds reinforce societal progress. This includes virtual public services, immersive healthcare, education, and cultural heritage experiences that are accessible, ethical, and aligned with EU values. The fourth pillar, “Openness and governance,” addresses the risks of market concentration and closed ecosystems. The strategy promotes open standards and interoperability, supports technical forums and regulatory sandboxes, and advocates EU participation in global digital governance bodies.

The strategy’s specific aims converge on ensuring that virtual worlds reflect fundamental EU values and rights. It seeks to empower citizens, encouraging safe and confident use of Web 4.0. The Commission emphasizes inclusivity, human-centric design, transparency, sustainability, and freedom of choice, as reflected in the Citizens’ Panel’s eight principles. It also aims to position Europe as a significant global actor in virtual-world technologies, by preventing dominance by major tech platforms and fostering diverse regulatory and technical leadership.

To translate strategy into practice, the Commission proposes ten flagship actions. These include promoting skills and diversity through targeted funding and talent attraction, establishing a public toolbox by early 2024, and curating research on health, well-being, and children’s use of immersive technologies via Horizon Europe. A European Partnership is envisaged to define the industrial roadmap. Additionally, support will be granted to cultural and creative industries, counter-fake toolkits, and regulatory sandboxes that allow member states to test innovative XR services under controlled conditions. Flagship pilot projects like CitiVerse and the European Virtual Human Twin are funded under Horizon and Digital Europe programmes to drive virtual applications in smart cities. The Commission also intends to coordinate an expert group for policy alignment among member states and establish multi-stakeholder technical governance frameworks from the end of 2023. A monitoring system is planned to track developments and ecosystem maturity, in cooperation with member states and stakeholders starting in early 2024.

The strategy is grounded in Europe’s existing regulatory framework, including GDPR, Digital Services and Markets Acts, Copyright and Accessibility law. This regulatory foundation provides clarity, reducing uncertainty and fostering investor confidence in Web 4.0 development. In essence, the EU’s Web 4.0 and Virtual Worlds strategy invests in citizen-centric readiness, business stimulation, public-sector potential, and global interoperability. The strategy acknowledges that realizing these goals will require long-term effort involving collaboration across countries, industries, academia, and civil society. With estimated global market growth from €27 billion in 2022 to €800 billion by 2030 and more than 860 000 XR-related jobs expected in Europe by 2025, the EU’s approach aims to prepare its economy and society for an immersive future while retaining agency in shaping it.

4.2.6 Finland

Finland has strategically positioned itself at the forefront of European nations in its pursuit of virtual worlds technology development with the launch of the national “Metaverse Initiative by the Finnish Ecosystem” [i.13] in 2023. The initiative signals a public-private partnership to achieve global leadership in virtual world technology by the year 2035. The strategy was prepared through collaboration of over 400 stakeholders from diverse sectors, including prominent Finnish industries, leading academic institutions, and various governmental bodies, all under the guidance of Business Finland. The initiative articulates the country’s vision for a virtual worlds industry within Finland, leveraging the nation’s core values and existing technological strengths.

The strategy of the Metaverse Initiative identifies key focus areas that will drive this development, including the advancement of underlying technologies, the cultivation of robust business collaboration, the facilitation of broad societal integration of virtual world use cases, the exploration of transformative healthcare solutions utilizing virtual environments, and the promotion of industrial adoption of virtual world technologies to enhance efficiency and sustainability. A significant emphasis is placed on ensuring the ethical and responsible development of virtual

worlds, with a firm commitment to prioritizing user privacy, ensuring safety and security within virtual environments, and promoting inclusivity across all segments of the population. Furthermore, Finland intends to capitalize on its established strengths in technology, its globally recognized education system, and its unique geopolitical position to foster international collaboration and emerge as a trusted and impartial global leader in the rapidly evolving immersive experiences domains.

Finland's strategic emphasis on a value-driven virtual world, deeply intertwined with its national identity, indicates a long-term commitment that extends beyond immediate economic gains. This approach aims to cultivate a unique and responsible virtual world ecosystem. The consistent highlighting of Finnish values such as well-being, freedom, openness, and trust as foundational principles for virtual world development suggests a deliberate strategy to differentiate Finland's approach. This value-centric strategy could attract a specific segment of users and developers who prioritize these ethical and societal considerations, fostering a distinct and responsible digital society.

Finland's virtual world strategy is not a standalone policy but is fully integrated with its broader digital transformation objectives. The cornerstone of the broader programme is Finland's Digital Compass policy [i.14], which was adopted by the government in 2022. This strategic document establishes comprehensive national targets aimed at promoting the effective integration and utilization of digital systems throughout all facets of Finnish society. The Digital Compass prioritizes several key areas, including the enhancement of digital literacy and skills across all demographic groups within the population, ensuring the widespread availability of secure and efficient digital infrastructure to support connectivity and innovation, actively promoting the adoption of digital technologies and solutions within small and medium-sized enterprises to boost their competitiveness, and continuously enhancing the quality and accessibility of citizen-centric public digital services to improve efficiency and user experience.

4.2.7 Japan

Ryūgukoku, the flagship metaverse project under Japan's "Metaverse Economic Zone," is an industry-led initiative constructing an open, interoperable virtual world using PEGASUS World Kit [i.15]. Framed as a moving city or castle, it integrates gamified UX, auto-learning avatars, and a "Multi-Magic Passport" for identity, payments, and NFT portability. Founded by leading tech, finance, and manufacturing firms—Mitsubishi, Fujitsu, Mizuho, MUFG, JCB, Sampo, Resona, Toppan, and Yamaha—the initiative blends XR, fintech, and ICT to create a shared infrastructure that supports enterprise digital transformation. Demonstration experiments embed real-world products into virtual experiences for marketing, training, and consumer interaction. This platform is built to enable seamless movement of users, assets, and data across multiple metaverse realms, while extending its utility beyond Japan. Ryūgukoku exemplifies Japan's distinctive model: private-sector-driven innovation underpinned by public policy support, aiming to establish a globally scalable, open metaverse ecosystem.

The Japanese government has identified the virtual world as a strategic priority for its future economic growth and technological advancement. When he took office, Prime Minister Fumio Kishida explicitly recognized virtual worlds as critical components of Japan's strategy for economic revitalization and digital transformation. This direct involvement from the highest level of government signifies the national importance of virtual worlds as a strategic priority, suggesting a concerted effort to create a supportive ecosystem for its development and adoption.

The web3 White Paper [i.16] is a critical document to understanding the Japanese government's strategy with respect to virtual worlds. The document presents a series of key policy recommendations designed to address immediate challenges and foster sustainable long-term growth within the sector. One of the primary recommendations is to **promote cross-sectional studies** to explore the convergence of cutting-edge technologies such as Artificial Intelligence (AI) and the Internet of Things (IoT) with virtual world technologies. This interdisciplinary approach directly supports the vision of Society 5.0, a Japanese government vision articulated since 2016. Society 5.0 envisions a human-centered society that balances economic advancement with the resolution of social challenges through the integration of cyber space and physical space.

The Web3 White Paper also advocates for **utilization of Verifiable Credentials (VC)**, **Decentralized Identity (DID)**, and **Digital Identity Wallets (DIW)** as key tools for enhancing digitization and data utilization while simultaneously mitigating privacy risks. The paper suggests fostering public-private collaboration to develop interoperable standards and frameworks in these areas, recognizing the importance of a unified approach to realizing the full potential of these technologies for a more secure and user-centric digital environment, which is particularly crucial for the widespread adoption of virtual worlds.

The Japanese government's Digital Agency, formed in 2021 for the purpose of accelerating digital adoption within government operations, ensuring digital equity among the population, and safeguarding cybersecurity and personal data privacy, has also provided an interim summary with clarifications regarding the virtual world [i.17], focusing on the importance of clarifying terminology and enhancing user convenience within these virtual spaces. This indicates a government-wide effort to establish a common understanding and promote user-friendly virtual world experiences.

While Japan has been proactive in outlining its vision and strategic objectives for virtual worlds, there is currently no single, comprehensive legal framework specifically governing the business use of virtual world technologies. Instead, the existing legal landscape relies on the applicability of established laws related to areas such as intellectual property rights, data privacy and protection, and the regulation of user behaviour within online environments. Recognizing the need to adapt to these emerging technologies, Japanese authorities, including government agencies and local municipalities, are actively engaged in exploring and developing solutions to address the unique legal challenges presented by virtual world technologies. This includes ongoing efforts to amend existing legislation to more appropriately address the specific nuances of virtual world businesses and activities, ensuring that the legal framework remains relevant and supportive of innovation in this domain.

Through a combination of high-level endorsements, dedicated government bodies like the Japan government's Ministry of Economy, Trade and Industry's Web4 Policy Promotion Office, and comprehensive policy documents such as the web4 White Paper, Japan is laying a robust foundation for the development and adoption of virtual worlds technologies. Key initiatives like the Japan Metaverse Economic Zone demonstrate a strong commitment to fostering public-private partnerships and building a foundational virtual worlds ecosystem. Japan is exploring the diverse potential of virtual worlds to transform industrial applications, tourism and culture, government services, and education and research. The government is also actively promoting investment through funding mechanisms, incentives, and collaborative projects. While the regulatory landscape for virtual worlds technologies is still evolving, Japan is actively engaging in discussions on digital identity, data governance, and international standard-setting efforts. Leveraging its strengths in technology, content creation, and a proactive government approach, Japan is well positioned to become a significant player in the global virtual world arena.

4.2.8 Saudi Arabia

Through strategic government initiatives initiated as part of its broad Digital Economy Policy framework of Vision 2030, Saudi Arabia has positioned itself as a leader in development of virtual worlds. The Saudi government views virtual worlds technologies as a critical component of its strategy to transform and diversify its economy through technology leadership. It is implementing many well-funded programs to foster innovation and attract talent to work on its projects.

The Saudi Digital Government Authority has implemented multiple initiatives to integrate virtual world technologies into its government services. These provide virtual spaces where people can interact with government entities and access services through immersive digital interfaces.

There is also a strong commitment on the part of the Saudi government to attract private sector technology businesses to it through major commercial development projects. The first and best known Saudi government program to drive virtual world technology development and adoption is NEOM. NEOM is a \$500 billion futuristic city project and testbed in northwestern Saudi Arabia, specifically in the Tabuk Province, along the northern edge of the Red Sea and the Gulf of Aqaba, which includes dedicated virtual worlds technologies and components. Through partnerships with global technology companies, NEOM is developing virtual replicas of the city's infrastructure and creating immersive digital experiences that complement the physical environment.

In parallel with NEOM, the Saudi Ministry of Communications and Information Technology (MCIT) has launched a specialized Metaverse Academy to develop local talent in AR/VR technologies, 3D modeling, and other skills essential for metaverse development. This academy aims to create 25,000 jobs in the virtual worlds technology sector by 2030. The Saudi Data and AI Authority (SDAIA) has established the ThinkTech initiative, providing funding and technical support for startups developing virtual world use cases with significant social or economic impact. This program includes dedicated investment for projects focusing on virtual world technologies applied to healthcare, education, and tourism.

The Saudi Tourism Authority has funded development of detailed virtual replicas of cultural and historical sites across the Kingdom, allowing virtual tourists to experience Saudi heritage through immersive virtual world environments. This project aims to both preserve cultural heritage and promote tourism.

Finally, it has established special economic zones with tax incentives and regulatory sandboxes specifically for companies developing virtual world technologies, allowing for experimentation with new business models in controlled environments.

The Saudi government has also put in place a regulatory environment for virtual worlds in the country. The National Data Management Office has developed specific data governance frameworks applicable to virtual world environments, ensuring proper data management practices. These regulations address data privacy, security standards, and sovereign data control in virtual environments. Communications and Information Technology Commission has established regulatory guidelines for virtual world platforms operating in Saudi Arabia, focusing on digital content standards, user protection measures, and technical requirements for virtual world service providers.

Finally, the Saudi Central Bank has been exploring central bank digital currency applications that could integrate with virtual world economies, providing a regulated framework for virtual transactions and digital asset exchanges within these platforms.

These programs are rapidly adapting in response to experiences gained and lessons learned on the ground. The Saudi government is refining its approach to virtual development, balancing innovation with cultural values and regulatory needs. Analysis of recent policy documents suggests that the country will soon release a comprehensive national virtual world strategy that will coordinate efforts across multiple government entities.

4.2.9 South Korea

The South Korean government has set an ambitious goal to become the fifth-largest country in the global virtual world market by 2026. This objective requires substantial investment and coordinated effort across various sectors, including talent development, infrastructure enhancement, ecosystem building, and the establishment of appropriate governance frameworks. The government's commitment to achieving this goal underscores the strategic importance it places on the virtual world as a key driver of future economic prosperity and technological leadership.

Published in January 2022, the Emerging Metaverse Industry Promotion Strategy [i.18] aims to support South Korea's response to disruptive innovation and emerging technologies, positioning the nation for future success in the digital realm. The strategy focuses on four main pillars: invigorating the virtual world platform ecosystem, nurturing experts and talent, fostering specialized companies, and creating an exemplary virtual world that is ethical, safe, and inclusive. MSIT's proactive approach includes providing financial support, promoting collaboration between companies, fostering technology development, and encouraging regulatory innovation to create a sustainable virtual world ecosystem.

To further solidify its commitment to the development of virtual worlds, South Korea's government passed the Metaverse Industry Promotion Act [i.19] in August 2024. This legislative action complements the government's strategic plans by creating a Metaverse Policy Deliberation Committee, chaired by the Prime Minister, to discuss and formulate policies related to the virtual world ecosystem. The Act also mandates the Minister of Science and Information and Communication Technology to establish a basic plan for virtual worlds every three years, ensuring a consistent and long-term approach to the industry's development. This legal framework builds upon the Ministry of Science and Information and Communications Technology's non-binding guidelines on the metaverse, which emphasize core values such as secure identity, safe experience, and sustainable prosperity. These guidelines also outline eight practical principles for virtual world system developers and users: promoting authenticity, autonomy, reciprocity, respect for privacy, fairness, personal information protection, inclusiveness, and responsibility for the future. While the integration of these principles into regulation is still under consideration, the government has taken initial steps by developing virtual world-specific regulation amendments aimed at protecting minors from sexual harassment.

In March 2025, the South Korean government announced the creation of a Metaverse Fund with a target size of approximately 40 billion Korean Won. This fund aims to boost emerging technologies within the virtual world sector, with a focus on investing in small and medium-sized enterprises that are developing key foundational

technologies such as extended reality (XR), artificial intelligence (AI), digital twins, and blockchain. The fund will consist of both government reinvestment and private contributions, demonstrating a collaborative approach to financing virtual world innovation. A significant portion of the fund's allocation will be directed towards fostering AI integration within virtual world enterprises and supporting their international expansion and export activities. This initiative underscores the South Korean government's commitment to providing financial backing and strategic support to companies driving the development and global reach of virtual world technologies. and the Metaverse Industry Promotion Act, demonstrating a strong governmental commitment to innovation, talent development, and the creation of a safe and prosperous virtual world.

The South Korean capital is also setting itself up to be a testbed for virtual world technologies. The Seoul municipal government has launched Metaverse Seoul, the world's first virtual public administration platform, marking a significant step in integrating virtual world technology into civic services. This initiative, with an investment of 3.9 billion won, aims to enable people to access various public services, handle civil complaints, and engage in consultations virtually through 3D avatars and immersive environments. The platform replicates key city landmarks and offers virtual social events, e-book libraries, and spaces for business and legal discussions. While still in its early phases, Metaverse Seoul represents a pioneering effort to enhance accessibility and convenience for people by leveraging the capabilities of virtual worlds for urban governance and public engagement. The project is planned for phased expansion, with future stages aiming to integrate more services and connect local industries with foreign investors, ultimately incorporating virtual and augmented reality into the city's infrastructure management.

Looking ahead, South Korea aims to continue its proactive approach to virtual world development, with a focus on fostering international collaboration and setting global standards. The government has expressed its intention to actively help domestic companies compete with global players by supporting cooperation, technology development, and regulatory innovation. South Korea also recognizes the importance of international cooperation as a key enabler for achieving its goal of becoming a leading virtual world market. By participating in global discussions and sharing its experiences, particularly through participation in many working groups within international standards development organizations, South Korea seeks to contribute to the development of international norms and best practices for virtual worlds, ensuring cohesive and interoperable virtual worlds.

4.2.10 United Kingdom

The United Kingdom is currently developing a national metaverse strategy, embedded within its digital policy ("Web3 and Metaverse Strategy"). The responsible authority is the Department for Science, Innovation and Technology (DSIT), aiming to position the UK as a global hub for immersive technology innovation. The UK government is actively engaged in fostering the development and application of virtual world and virtual world technologies through a variety of initiatives and a stated pro-innovation regulatory stance. These efforts span across different sectors, including creative industries, cultural heritage, energy, and intellectual property. At a high level, the government of the United Kingdom aims to foster the growth of virtual world technologies by prioritizing innovation and monitoring the evolving landscape. Before developing any specific laws or policies, the government has expressed the need to see how these technologies will develop and then establish guiding principles for regulation.

In a Digital Catapult report entitled *The metaverse meets Web3: the state of convergence in the UK*, released in July 2023, the government's ambition to leverage these technologies for accelerating the development of the country's cyber-physical infrastructure is made clear [i.20]. The report emphasizes that virtual worlds, in this context, can be seen as a cyber-physical system that integrates immersive technologies with other enabling technologies to merge physical and digital realms through more embodied interactions. A key aspect of this approach is the creation of a central coordination function to ensure different regulatory bodies work together effectively concerning virtual worlds. While a single, formally designated body explicitly named for this purpose has not been officially announced in the publicly available documents and strategic plans reviewed, the Digital Regulation Cooperation Forum (DRCF) is the closest existing entity that aligns with this aim. The DRCF brings together the UK's four digital regulators: the Competition and Markets Authority (CMA), the Financial Conduct Authority (FCA), the Information Commissioner's Office (ICO) and Ofcom. The DRCF's remit is broader than just virtual worlds, but it is well positioned to foster coherence and collaboration in digital regulation across these bodies. As virtual worlds intersects with areas like competition, financial services, data privacy, and online content, the DRCF serves as a crucial platform for these regulators to align their approaches and develop a coordinated response.

To actively drive virtual world technology development, the government is investing in three key sectors: creative industries (games, entertainment), cultural heritage and energy. The Convergent Screen Technologies And performance in Realtime program, funded by the UK Arts and Humanities Research demonstrates a commitment to building the fundamental technologies required for immersive experiences and virtual production, which are essential for virtual worlds. In Scotland, the Museums in the Metaverse project, funded through the UK Government's Innovation Accelerator program demonstrates an interest in exploring the social and cultural applications of virtual worlds. The collaboration on the Industrial Metaverse for Fusion Energy (STEP) by the UK Atomic Energy Authority highlights the potential of these technologies for complex industrial advancements. Additionally, the Visit Wales metaverse experience showcases a proactive approach to using virtual platforms for economic promotion through tourism.

The government is also focused on understanding and addressing the broader implications of virtual worlds. The UKIPO's report analyzing the virtual worlds IP landscape [i.21], published by the Intellectual Property Office in March 2024, indicates an effort to track innovation and consider future policy needs in this area. The overarching aim is likely to align with the government's broader technology strategies, though a single, dedicated metaverse strategy document is not explicitly cited.

At the time of preparation of the present document, the UK government is considering how existing and potentially new regulations will apply to the evolving landscape of virtual worlds. The UK's Online Safety Bill, a landmark piece of legislation aimed at making online spaces safer, is anticipated to extend its scope to encompass virtual environments. This extension will protect users within virtual worlds and extend the same protections against illegal and harmful content that are being established for traditional online platforms. This includes addressing issues such as hate speech, terrorism content, and child sexual abuse material, recognizing that these harms can manifest in immersive digital spaces as well.

Data protection and privacy are also concerns for the UK government as virtual world technology develops. Existing regulations, such as the General Data Protection Regulation (GDPR), which continues to be relevant in the UK despite Brexit through the UK GDPR, and the Data Protection Act 2018, provide a foundational framework for data protection and user rights. However, the government acknowledges that these regulations will need to be adapted or supplemented to effectively address the specific challenges posed by virtual worlds. This includes considerations around data ownership, consent mechanisms within virtual environments, the potential for increased surveillance and profiling, and the cross-border nature of many virtual world platforms. The ICO, the UK's independent data protection authority, will likely play a crucial role in providing guidance and enforcement in this area.

Furthermore, the government is examining potential harms that are unique to or amplified within virtual worlds. The government is considering the need for specific regulatory frameworks and platform responsibilities to address these issues. This may involve exploring concepts like virtual codes of conduct, moderation policies tailored to immersive environments, and mechanisms for reporting and addressing harmful behaviour within virtual worlds.

4.2.11 United States

The United States currently has no formal, coherent national metaverse strategy at the federal government level. However, various strategic developments are underway, driven by federal agencies, legislative initiatives, and industry partnerships. Key institutions such as the White House Office of Science and Technology Policy (OSTP), the National Institute of Standards and Technology (NIST), and departments within Defense, Commerce, and Education are working on foundational concepts.

Despite the absence of a centralized strategy, several U.S. federal agencies have moved forward with significant initiatives that use virtual world enabling technologies as well as AR and VR for the delivery of information, design and research purposes:

- NASA's Jet Propulsion Laboratory has developed a shared virtual workspace where engineers can collaborate on designing future planetary and deep space remote sensing satellites, landers, and autonomous robots. This environment demonstrates the practical utility of virtual world technologies for complex scientific collaboration. More ambitiously, NASA has created a complete digital twin of Mars with realistic Martian gravity, day and nighttime light conditions, atmospheric conditions, space suits and rovers, and 400 square kilometers of terrain. This initiative represents one of the most sophisticated

applications of virtual world technology within the U.S. government, creating a simulation environment that enhances mission planning and scientific exploration.

- Several US defense agencies are also studying or have begun deploying virtual world technologies. Virtual reality is in use for simulation of battles and Augmented Reality displays have been evaluated as part of the hardware distributed to armed forces. The US Air Force Research Lab has several initiatives underway to apply virtual world technologies to its design and delivery of advanced weapons and reconnaissance systems. These include using digital twins for factories and in the planning of manufacturing.
- Contractors for the U.S. Department of Agriculture's Forest Service are using AI and digital twin technologies to simulate wildfires in a virtual world to better understand their dynamics and how they can slow or stop their spread. This initiative highlights the potential for virtual world technologies to address critical environmental challenges and improve disaster response capabilities.

Most virtual world technology development in the US is taking place organically within the private sector, without government funding or guidance. Although their highest priorities are on advancement of AI, many leading American technology companies continue to make substantial investments in virtual world technology development. These investments are made in internally-funded research and development projects as well as through acquisition of firms and expertise that can contribute to their achievement of fully integrated, proprietary technology silos. These developments span the all parts of virtual world technologies, especially the hardware for displays and software necessary to create and deliver immersive experiences in the workplace, education and private life.

Legislation that, while not focused on virtual worlds, would have encouraged (or even required) virtual world interoperability has stalled. The proposed Augmenting Compatibility and Competition by Enabling Service Switching Act of 2021 would have created a committee within the Federal Trade Commission (FTC) to develop standards for interoperability and online data portability. If passed the legislation would grant the FTC enforcement authority to penalize platforms that violate the legislation, however, according to recent analyses, the act has not been taken up in since 2022. Another bill that, also did not focused on virtual worlds but on the US technology sector overall, was proposed but has not advanced. The Innovation and Competition Act was designed to fund an acceleration in semiconductor manufacturing, research in robotics, biotechnology, and artificial intelligence.

While these bills have failed to advance, and the current US administration is not focusing on the development of regulations to reducing privacy, ethical, and safety risks, or to fund new overarching strategies, the National Institute of Standards and Technology (NIST) has actively engaged with virtual world stakeholders in standards development to document virtual world requirements. NIST conducts regular workshops, events and publishes reports focusing on different approaches to manage cybersecurity and the use of AI in virtual worlds.

4.3 Comparisons and contrasts of strategies

4.3.1 Introduction

The virtual world strategies of the countries profiled in this document illustrate diverse approaches, reflecting the unique priorities and strengths of the respective regions and countries. The European Commission's strategy, with its emphasis on citizen rights, ethical considerations, and the creation of an open and inclusive digital environment, sets a benchmark rooted in its core values. The analyses performed for the preparation of the present document reveal that other strategies, often driven by specific economic, industrial, or societal goals, are popular. When benchmarking virtual worlds strategies of Baden-Württemberg, China, the UAE (Dubai), Finland, Japan, Saudi Arabia, South Korea, the UK, and the US against the European Commission's strategy, several strengths and weaknesses emerge for each.

Baden-Württemberg's metaverse strategy focuses on regional innovation, XR adoption in SMEs, and practical testbeds, emphasizing economic impact and collaboration with local research institutions. In contrast, the European Union's strategy is broader and more regulatory, prioritizing governance, digital rights, and interoperability across member states. While the EU sets strategic standards for a unified digital market, Baden-Württemberg acts as a decentralized pioneer implementing immersive technologies on a regional scale.

China's strategy, with its strong government backing and industrial focus, has the potential for rapid implementation and significant impact on its manufacturing sector, a strength not as pronounced in the EU's broader digital economy approach. However, its potential lack of emphasis on individual rights and ethical considerations could be a weakness compared to the EU's citizen-centric framework.

Dubai's strategy excels in its ambition to become a global hub and its proactive development of regulatory frameworks for virtual assets, areas that the EU is still navigating. However, its reliance on attracting foreign talent and investment might be a weakness in the face of global competition, while the EU aims to build its own strong ecosystem.

Finland's key strength lies in its strong ethical and sustainability focus, aligning closely with the EU's values-driven approach but perhaps with a more specific emphasis on these principles from the outset. A potential weakness for Finland could be the risk of being overshadowed by larger global players, a concern the EU also shares.

Japan's strength is its industry-led economic zone approach, demonstrating a practical and commercially-oriented strategy. However, the national strategy is not as clearly articulated as that of other countries and might be a weakness compared to the EU's more cohesive framework.

Saudi Arabia's strong government backing and alignment with Vision 2030 provide a clear direction, particularly in leveraging virtual worlds for tourism and smart city development, which are less central to the EU's current emphasis. However, its evolving regulatory landscape could be a weakness compared to the EU's more established legal frameworks.

South Korea's proactive legal framework, significant government funding, and explicit focus on talent development are notable strengths, potentially giving it a competitive edge over the EU in these areas. A possible weakness is its cautious stance on cryptocurrency, which could limit certain virtual world use cases.

The UK's strength lies in its recognition of virtual worlds within a broader digital infrastructure strategy and the active involvement of industry bodies. However, the lack of a unified national strategy and identified skills gaps could be weaknesses compared to the EU's more defined approach. A project concluding in June 2025 could define a more focused and concrete strategy with respect to virtual world development.

The US's decentralized, sector-specific approach fosters innovation, a strength in its adaptability. However, the lack of a unified national strategy and potential regulatory uncertainties could be weaknesses compared to the EU's more centralized and principle-based framework. In view of the Trump administration's broad reduction of support for national innovation programs, in particular public programs to support technology initiatives and education, it is unlikely that there will be a more clearly defined virtual world strategy or comprehensive initiatives with regulation.

In the following clauses, the present document examines three different aspects of the national strategies summarized in table 2.

Table 2. Comparison of national virtual world strategies

Country	Development Approach	Priority Emphasis	Skills Development	Strengths vs. EU	Weaknesses vs. EU
Baden-Württemberg / Germany	Top-down, centrally coordinated	XR as driver of innovation; embedded in the regional digital strategy	close collaboration with universities and research institutions	Strong regional proximity and targeted support for local SMEs and research	Lower visibility and outreach; less detailed measures on governance and interoperability
China	Top-down, centrally coordinated	Industrial applications; Hardware manufacturing; Alignment with state values	Educational components in regional plans	Rapid implementation; Clear economic targets; Strong manufacturing focus	Less emphasis on user rights; Limited multi-stakeholder input
Dubai / UAE	Hybrid with government direction and private collaboration	Economic diversification; Global leadership; Clear governance principles	Metaverse Pioneers programme	Stronger financial commitment; Comprehensive regulatory framework; Clear self-governance principles	Low integration with broader digital policies
Finland	Highly collaborative with 400+ stakeholders	Value-driven approach emphasizing Finnish values; Integration with digital transformation	Digital literacy across demographic groups	Value-centric approach; Strong stakeholder engagement; Integration with Digital Compass	Smaller scale; Less explicit economic targets
Japan	Public-private consultation	Alignment with Society 5.0; Human-centered technology; Convergence with AI and IoT	Mentioned without specific targets	Strong alignment with societal vision; Focus on emerging tech convergence	Less regulatory clarity; Less defined governance structure
Saudi Arabia	Government-led with private sector attraction	Economic diversification; Technology leadership; Commercial development	Metaverse Academy targeting 25,000 jobs by 2030	Stronger financial commitment; Clear job creation targets; Test bed development	Less emphasis on ethical frameworks; More centralized approach
South Korea	Government-led with legislative backing	Market position (5th globally by 2026); Industry promotion	Core pillar of strategy with talent development emphasis	More specific economic targets; Legislative backing; Clear governance structure	Less emphasis on interoperability; More nationally focused
United Kingdom	Consultative through existing regulatory bodies	Cyber-physical infrastructure; Sector-specific applications	Not prominently featured	Focus on practical applications; Pro-innovation regulatory stance	No unified strategy document; Less coordinated approach
United States	Fragmented, primarily private sector-driven	No unified priorities; Agency-specific practical applications	No coordinated strategy	Agency innovation freedom; Strong private sector investment	No comprehensive strategy; Lack of coordination; Limited ethical oversight

4.3.2 Development approach

The development approaches to virtual world strategies vary significantly across regions. The European Union has adopted a balanced approach with ten specific actions while incorporating citizen panels to provide public input. This multi-stakeholder model is similar to Finland's approach, where over 400 stakeholders from industry, academia, and government collaborated on the Metaverse Initiative by the Finnish Ecosystem under Business Finland's guidance.

China presents a strongly top-down model, with its Ministry of Industry and Information Technology releasing a three-year action plan (2023-2025) developed in conjunction with several ministries and government agencies. This centralized approach extends to regional initiatives in Shanghai and Beijing, where officials have announced specific economic targets for virtual world technology industry growth.

The UAE, particularly Dubai, demonstrates a hybrid approach through its Dubai Metaverse Strategy, which involves government direction combined with collaboration through initiatives like the Metaverse Alliance that includes international companies, entrepreneurs, and startups. South Korea shows a similar pattern with its Emerging Metaverse Industry Promotion Strategy and establishment of a Metaverse Policy Deliberation Committee chaired by the Prime Minister.

Japan and the United Kingdom have taken more consultative approaches, with Japan's Web3 White Paper advocating for public-private collaboration, while the UK operates through existing regulatory bodies like the Digital Regulation Cooperation Forum to coordinate responses across sectors.

The United States stands out as the only region without a comprehensive national strategy, with development occurring primarily through private sector initiatives and isolated government agency projects.

4.3.3 Priority emphasis

Each region emphasizes different priorities in their virtual world strategies. The European Union focuses on balancing technological advancement with citizen well-being, ethical development, and fostering a competitive European ecosystem. The emphasis on interoperability, governance frameworks, and international cooperation reflects the EU's broader digital market goals.

Baden-Württemberg's metaverse strategy prioritizes fostering regional innovation through Extended Reality (XR) technologies, with a focus on supporting small and medium-sized enterprises and local research institutions.

China prioritizes industrial applications and hardware manufacturing while ensuring alignment with social and political values. This is evident in its promotion of blockchain technology while banning cryptocurrencies in virtual worlds.

The UAE and Saudi Arabia share a focus on economic diversification and positioning themselves as global hubs for virtual world businesses. Both emphasize infrastructure development, regulatory frameworks, and integration with government services, with the UAE particularly focused on establishing clear principles through its Responsible Metaverse Self-Governance Framework.

Finland uniquely emphasizes a value-driven approach, highlighting Finnish values like well-being, freedom, openness, and trust as foundational principles for virtual world technology development. This is integrated with broader digital transformation objectives outlined in Finland's Digital Compass policy.

Japan aligns its virtual world technology strategy with its Society 5.0 vision, emphasizing human-centered technology that balances economic advancement with social challenges. South Korea focuses explicitly on becoming the fifth-largest country in the global virtual world technology market by 2026, demonstrating a clear economic and competitive focus.

The UK prioritizes virtual worlds as part of its cyber-physical infrastructure development, while the United States has no unified priorities, with initiatives scattered across various federal agencies focusing on practical applications rather than strategic development.

4.3.4 Skills development

Skills development features prominently in several strategies. The UAE's Metaverse Pioneers programme explicitly aims to train government employees in the use of virtual world technologies. Saudi Arabia's Metaverse Academy targets development of 25,000 jobs in the virtual worlds sector by 2030.

South Korea emphasizes nurturing experts and talent as one of the four main pillars in its strategy. Finland incorporates skills development within its Digital Compass policy, which prioritizes digital literacy across all demographic groups.

The European Union, Japan, and the UK mention skills development in broader terms without specific targets. China's regional plans, particularly in Shanghai and Beijing, include mentions of educational components. The United States has no coordinated skills development strategy for virtual worlds.

4.3.5 Conclusion

The comparative analysis of strategic initiatives reveals distinct approaches to virtual world development across regions. The European Union and Finland pursue value-driven, multi-stakeholder strategies that emphasize ethical considerations alongside technological advancement. Asian countries like China, South Korea, and Japan demonstrate more specific economic targets with varying degrees of government direction. The UAE and Saudi Arabia leverage substantial financial investments to position themselves as global hubs, while the UK takes a sector-specific approach. The United States stands alone in its lack of a unified national strategy, relying primarily on private sector innovation.

The differences outlined above reflect varying priorities, governance structures, and economic objectives across regions. While some prioritize rapid market development and economic returns, others emphasize responsible innovation, ethical frameworks, and societal integration. As virtual world technologies continue to evolve, these strategic differences will likely shape how virtual worlds develop globally, influencing everything from technological standards and interoperability to user rights and digital citizenship.

5 Standardisation strategies

5.1 Introduction

In the above strategic roadmaps, only the European Union and China explicitly mention standardization for virtual world domains and assign funding to the standardization goals. Through the ViWISSO project, the European Commission is expanding and clarifying its roadmap with respect to standardization activities. After the topic of extended reality was explicitly mentioned in the Chinese standardization strategy, the Chinese Ministry of Industry and Information Technology (MIIT) established its national Metaverse Standardization Working Group.

The purpose of this chapter is to document the approaches of European Commission, China and other countries with respect to virtual world standardization activities in order to permit comparison and planning for further investments.

5.2 European Union and member states

The EC's overarching standardization strategy [i.22] aims to support the green, digital, and resilient transformation of the single market. It seeks to assert European leadership in standardisation for key industrial ecosystems while reducing dependencies and shaping global norms aligned with EU values and regulations. Emphasis is placed on standardisation for emerging technologies in critical areas such as digital services, data spaces, and cybersecurity. Terms such as metaverse, VR and AR are not explicitly mentioned in the EC's standardization strategy, however, accelerating digital transformation, increasing data interoperability, cybersecurity, and AI governance are included and all of these topics are foundational, enabling technologies for immersive experiences and virtual worlds.

Formed in 2018, the ETSI Industry Standardization Group on Augmented Reality Framework focuses on developing standards to increase the interoperability of AR components, systems and services. The group has worked on specifications including a reference model architecture, and defined relevant components and interfaces required for any open and interoperable AR system. It has published six Group Standards (GS) and five Group Reports (GR), including the virtual world Standards Landscape Report [i.1], prepared by the ViWISSO project researchers. In addition, members of the ISG ARF have collaborated on the implementation of interfaces and wrappers to enable interoperability as part of two ETSI Special Task Force projects. The future activities of this group are being discussed as of the preparation of the present document.

France's standardization strategy does not explicitly mention virtual worlds or any of its components either, however, it promotes national competitiveness, ecological transition, digital inclusion, and social cohesion. It advocates for strong participation in European and international standardisation bodies and highlights the role of voluntary standards in future societal and technological transformations. Like the EU's standardization roadmap, the French strategy recognizes the importance of digital technologies for smart cities, cybersecurity, and accessibility. AI is not directly addressed in the French standardization roadmap, but data management, inclusivity, and digital infrastructure are emphasized. In 2023, AFNOR, the French national standardization organization, created a commission to study and provide standards for virtual worlds, initially focusing on terminology and concepts. Its first project in collaboration with ISO/IEC JTC1 SC24 WG8 is an update of the SEDRIS Standard Language Bindings Part 4C, published in 2006 and amended in 2012. Unfortunately, the work has not advanced and there is no update at the time of preparation of this document.

Germany's standardisation strategy focuses on enhancing innovation, reducing regulatory burdens, and opening global markets. It focuses on coordination among industry, government, and research to strengthen Germany's role in international standards development. The government's strategy acknowledges the importance of digitalisation, platform economy, and emerging technology. Standardisation is framed as an enabler of digital transformation, but immersive and simulated environments are not explicitly covered. Since the publication of the German strategy in 2016, however, in September 2023, the German national standardization organization, Deutsches Institut für Normung e.V. (DIN), created a committee focusing on virtual world technology and extended reality. The group monitors relevant standardization activities and coordinates with other committees and SDOs.

5.3 China

The China Standards 2035 programme [i.23] states that the country will seek to establish national and global dominance in strategic sectors by coordinating civil-military integration, upgrading standardization systems, and promoting international influence. The strategy is a cornerstone of China's long-term geopolitical and technological ambitions, following Made in China 2025. Virtual reality is explicitly named as a strategic target area, alongside AI, 5G, IoT, and intelligent healthcare. China aims to build rigorous standards in virtual worlds. There is also mention of virtual economy integration and platform dominance, implicitly aligning with metaverse and simulation ecosystems.

The Chinese Ministry of Industry and Information Technology (MIIT) established its national Metaverse Standardization Working Group in 2023. Table 3 provides the names of the working groups that have been defined and provides the names of companies or organization that have taken leadership of each standardization activity.

Table 3. Chinese Ministry of Industry and Information Technology (MIIT) Metaverse Standardization Projects (February 2025)

Metaverse Standardization Project	Industry Standard Leader
Industrial Metaverse Reference Architecture	China Institute of Electronic Technology Standardization
Metaverse computing power platform technical requirements	Inspur Electronic Information Industry Co., Ltd.
Metaverse Factory Planning and Construction Requirements	Kaos Industrial Intelligence Research Institute (Qingdao) Co., Ltd.
Metaverse Network Resource Digital Imaging Capability Grading Evaluation Method	China United Network Communications Co., Ltd.
Metaverse terminology	China Institute of Electronic Technology Standardization
Industrial Metaverse Application Assessment Method	China Institute of Electronic Technology Standardization
Industrial Metaverse Capability Maturity Model	China Institute of Electronic Technology Standardization
Metaverse Virtual Digital Human Generation Platform Construction Requirements	China Institute of Electronic Technology Standardization
Metaverse Virtual Exhibition Hall Construction Requirements	China Institute of Electronic Technology Standardization
Metaverse virtual Digital Human Construction and Classification	China Institute of Electronic Technology Standardization

At the time of the preparation of the report, the working groups have not revealed specific objectives or released any draft or completed standards in public and in English.

5.4 Japan

Japan's standardisation strategy, coordinated by the Japanese Industrial Standards Committee (JISC) and implemented via the Japanese Standards Association (JSA), focuses on enhancing industrial productivity, safety, quality of life, and environmental protection. It emphasizes harmonizing public-private cooperation, improving trade, and aligning with international frameworks such as ISO and IEC. The strategy does not, however, mention virtual worlds, VR, AR, AI, or related digital technologies explicitly. It mainly addresses general industrial standards across sectors such as manufacturing, civil engineering, and measurement systems. Digital transformation is implicitly supported through IT and factory automation standards but without focus on immersive technologies or virtual society [i.24][i.25].

At the time of the preparation of the present document, no JISC working groups relevant to virtual worlds were identified. It is known that several Japanese researchers are contributing to and the chair of the ISO/IEC JTC1 SC24 WG9 is a Japanese professor.

5.5 United Kingdom

The UK's strategy [i.26] states that it will use standards as tools for economic growth, innovation, and global competitiveness. It emphasizes public-private cooperation, flexible adoption of both formal and de facto standards, and responsiveness to emerging technologies. There is no explicit reference to virtual world or enabling technologies, but the strategy clearly addresses AI, digital services, data governance, and emerging technology governance. The UK also supports platform-based ecosystems and rapid standards adoption, indirectly covering aspects of the virtual economy and digital society.

It is noteworthy that the British Standards Institute (BSI) is the manager of the ISO/IEC JTC1 SC24 on Computer Graphics which is the group in which many standards relevant for or entirely focused on virtual worlds are developed. In addition, the BSI IST/31 committee is responsible for developing standards related to immersive technologies, including AR, VR and XR. The committee meets regularly and is actively working on several projects relevant to virtual worlds that it plans to submit to ISO/IEC JTC 1 SC24 for ratification.

5.6 United States

ANSI, the American National Standards Institute, published the United States Standards Strategy (USSS) in 2020 [i.27]. Metaverse or XR are not mentioned within this strategy. ANSI is the manager of ISO/IEC JTC1 within which subcommittee 29 members are standardizing audio, picture, multimedia and hypermedia coding and, through its Motion Picture Experts Group (MPEG), is one of the two most important ISO/IEC JTC1 working groups actively standardizing virtual world technologies. In addition, as mentioned in the strategic roadmap section above, NIST is actively engaged with virtual world stakeholders regarding requirements and use cases.

The U.S. federal government supports a voluntary, consensus-based, market-driven standardisation system. It seeks to maintain leadership in innovation, trade, and security through public-private collaboration, while aligning with World Trade Organization standards principles. There are no direct mentions of virtual worlds or many enabling technologies. However, the document strongly emphasizes AI, cybersecurity, digital services, and interoperability, which are critical components of immersive digital environments. It encourages cross-sector digital innovation, making it indirectly supportive of virtual economy initiatives.

5.7 Conclusion

A detailed examination of the standardisation strategies of five countries and the European Union for the present research project reveals that, with the exception of China, most countries do not have explicit standardization strategies focusing on virtual world technologies. The original EU standardization strategy, published in 2022, emphasizes digital sovereignty, data spaces, and AI, but avoids direct mention of virtual worlds. China is the most explicit, naming VR, AI, and platform infrastructures as focal points in its China Standards 2035 plan, aiming for global dominance.

In the table 4, the strategies examined in the present clause are compared with the scope of the domains defined in this project, as well as a focus on digital transformation. UK's strategy focuses on emerging digital standards, data governance, and AI, but lacks references to immersive technologies. The USA supports a market-driven, cross-sector innovation system, stressing AI, cybersecurity, and interoperability, yet omits specific terms like XR or virtual worlds. Japan focuses on industrial efficiency and safety, with minimal digital immersion focus. Across the board, AI and data infrastructure are recurring themes, while reality capture, digital twins, and human interface systems receive less attention, and topics of virtual societies and virtual economies remain very peripheral.

Table 4: Comparison of national standardisation strategies in eight virtual world domains

Country / Region [pub. year]	1. Virtual Worlds	2. Digital Transformation Focus	3. Infrastructure for Virtual Worlds	4. Data Management for Virtual Worlds	5. Artificial Intelligence	6. Reality Capture / Digital Twins	7. Human Interface Systems / Immersive Experiences	8. Virtual Society / Virtual Economy
Japan [~2019]	✗ Not mentioned	✓ Industrial and automation-focused	✗	✗	✗	✗	✗	✗
China [2018]	✓ Explicitly mentioned (VR, simulation)	✓ Strategic integration of emerging tech	✓ Focus on platform and integration dominance	✓ Platform-driven integration and control	✓ Explicitly mentioned	✓ Included (e.g. IoT, VR, simulation)	✓ VR devices and immersive tech mentioned	✓ Explicitly discussed
Europe [2022]	✗ Not mentioned directly	✓ Green and digital twin transition	✓ Digital sovereignty and infrastructure	✓ Common data spaces and interoperability	✓ Explicitly mentioned	✓ BIM and digital twin integration	✗	✗
France [2019]	✗ Not mentioned	✓ Inclusive and digital society	✓ Smart digital city systems	✓ Urban and services data governance	✗	✓ Smart territory implications	✗	✗
Germany [2016]	✗ Not mentioned	✓ Enabler of innovation and trade	✓ Platform economy support	✗	✗	✗	✗	✗
UK [~2024]	✗ Not mentioned	✓ Emerging tech and flexible regulation	✓ Enabling platform standards	✓ Data governance policies	✓ Clearly addressed	✗	✓ Implicit via digital UX and services	✓ Via innovation ecosystems
USA [2020]	✗ Not mentioned	✓ Cross-sector digital innovation	✓ Ecosystem and network readiness	✓ Emphasis on digital and secure data	✓ Clearly addressed	✗	✓ General user experience focus	✓ Via digital economy innovation