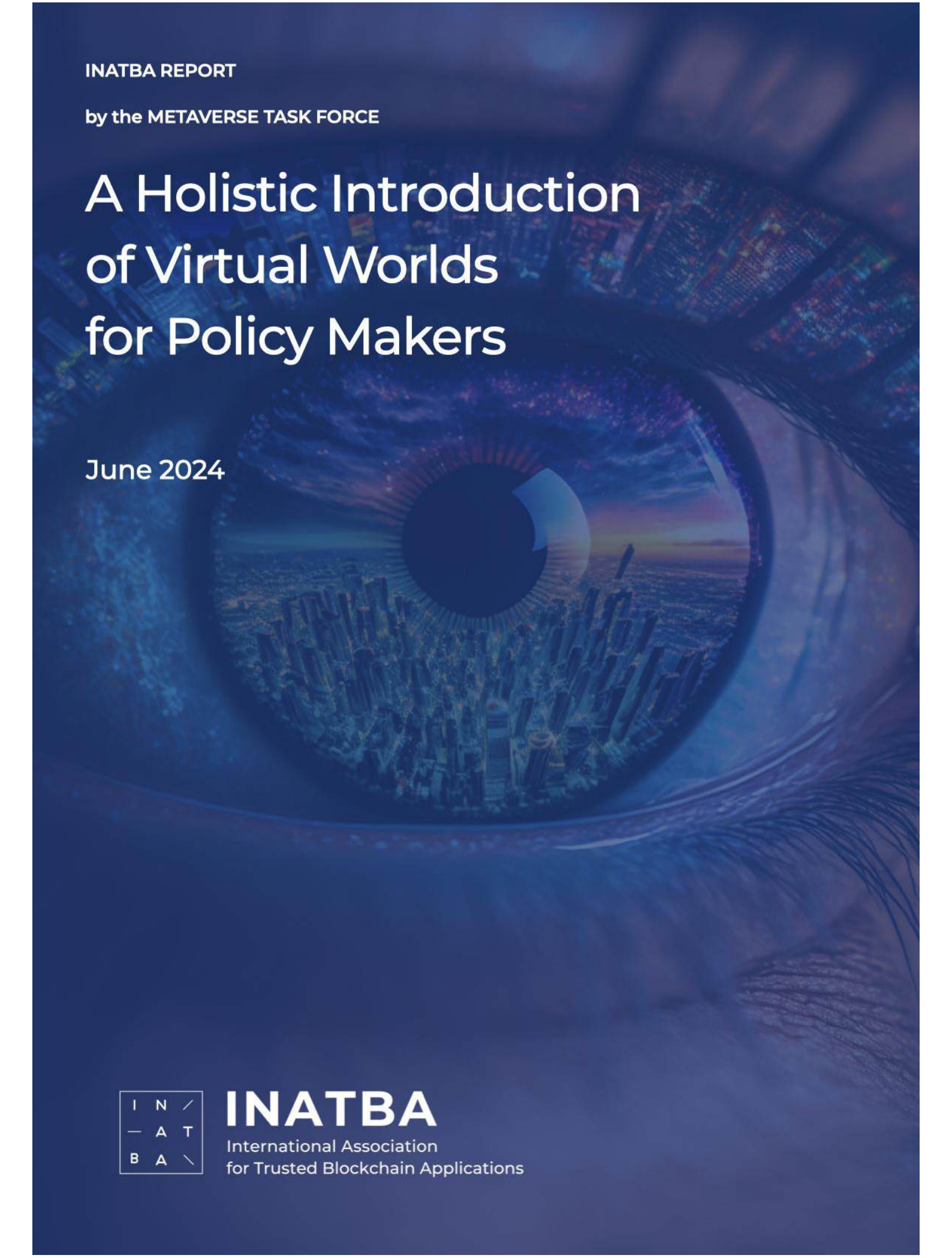
INATBA REPORT

by the METAVERSE TASK FORCE

A Holistic Introduction of Virtual Worlds for Policy Makers

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INATBA

International Association
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1. Executive Summary

In recent times, the Metaverse, once a fervently discussed topic, has seemingly receded from the forefront of public discourse. However, it is incumbent upon us to acknowledge that the Metaverse remains a pivotal and transformative concept with enduring significance. INATBA and its members approach this report to unearth a holistic analysis of the evolving nature of this technology, its inherent complexities, risks and hurdles.

This report is designed to delve into the Metaverse's ongoing relevance by concentrating on a crucial facet—the analysis of risks within the burgeoning Metaverse industry. As digital ecosystems continue to mature, it becomes increasingly imperative to systematically comprehend and mitigate potential risks associated with novel technological paradigms. By adopting a comprehensive approach, this analysis will not only scrutinize the existing regulatory framework applicable to the Metaverse but will also discern and elucidate risks that transcend the confines of current regulatory mechanisms.

Furthermore, it is imperative to acknowledge that the Metaverse, by its very nature, introduces challenges that may not be adequately addressed by existing regulations. This report will thus undertake the task of identifying and delineating risks that fall beyond the scope of current regulatory frameworks. A nuanced understanding of these multifaceted risks is indispensable for informed decision-making and effective policy formulation.

In the pursuit of a balanced and forward-looking approach, the report will culminate in the proposal of policy considerations. These recommendations will be crafted to not only address identified risks but also to facilitate the growth and expected societal impact of the Metaverse industry. Striking a delicate balance between regulatory measures and fostering innovation is paramount to ensuring the Metaverse's sustainable development.

By uncovering risks, exploring existing regulatory landscapes, and proposing insightful policy actions, INATBA members aim to provide valuable insights to policy makers and stakeholders navigating the intricate intersection of technology, regulation, and societal impact.

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2. Defining Terms

As we explore the rise and potential of the Metaverse, it is important to first define terms and provide context for this technology and its nuances. This section describes core definitions and considerations for terms used across this report, with a glimpse on the history of the term and the technology associated with it, and showcases both existing and future use cases, as well as the importance of this technology onto our society's future.

2.1 Definitions

2.1.1 What are the Metaverse and Virtual Worlds?

Throughout the document, the term Virtual Worlds and the Metaverse will be used interchangeably.For the authors of the report, the two terms describe the same phenomena. According to the Oxford English dictionary the term Metaverse is etymologically composed of two components: meta (Greek prefix **μετα** meaning post, after or beyond – denoting change, transformation, permutation, or substitution) and universe.



The concept of a Metaverse refers to the migration of various parts of the human experience from the physical to an increasingly immersive virtual world. To this end, the scope of the Metaverse seems to come in many shapes and sizes. To some, the existing social layers enabled by technology belong to the Metaverse, including social media, video games and video-enabled communications. While to others, the Metaverse must be a clearly described, immersive and virtual-first companion to the physical world.

As such, defining what the Metaverse is, and how segmented its presence may be, is an important, fundamental goal for this report. However, this is no easy task, as there are numerous definitions of Metaverse available in the literature. This will be the focus of this initial section of the INATBA Metaverse Report.

> *"The Metaverse is a massively extended and interoperable network of network of real-time rendered 3D virtual worlds, which can be experienced synchronously and persistently by an unlimited number of users with a sense of presence, associated with a continuity of data, such as identity,*

history, rights, objects, communications and payments."
– Matthew Ball, CEO Epyllion Companies

In the Metaverse study, requested by the JURI Committee of the European Parliament, the authors propose a definition according to which the Metaverse is a digital simulation of a multidimensional space. The Metaverse can be provided by public or private actors for single users or as a networking platform. It can mirror reality, create a simulation of an entirely new space and actors (bots), or mix both. There can be one, interoperable Metaverse or a myriad of four-walled Metaverses, quite alike today's social media.

In its 2022 report Gartner indicated that Metaverse technologies are nascent and as a combinatorial innovation, Metaverses require multiple technologies and trends to function. Contributing technologies and trends necessary for Metaverse include virtual reality (VR), augmented reality (AR), flexible work styles, head-mounted displays (HMDs), cloud technology, the Internet of Things (IoT), 5G, artificial intelligence (AI) and spatial computing.

To this end, the Metaverse is also a concept that involves various stakeholders, including both Web3 enthusiasts and private industry players. While 2021's Metaverse boom may be largely attributed to blockchain technologies, big tech corporations have been a big part in the development, marketing and adoption of the technologies that will eventually make up the Metaverse, and are, thus, eager to establish their positions in this emerging market.

For supporters of an interoperable, permissionless and open Metaverse, as well as for regulators, the investment of these companies raises concerns about the potential rise of a Closed Metaverse, where accessibility and market dominance is concentrated in the hands of a few entities. Understanding the key differences between the two is the core aspiration of this section of this report.

2.1.2 What is the Open/Permissionless Metaverse?

The image of a fully immersive world, an extension to the physical realm, one that everyone has access to and ownership of, has been the traditional vision of what this technology will look like in the future. However, this is not the only potential future for the metaverse. As such, an integral part of the Metaverse definition debate is the ownership and accessibility of the entire network. Establishing an Open Metaverse that leverages blockchain technology, ensuring unrestricted access and user ownership of data, is what this report defines as the open and permissionless Metaverse. However, ensuring that this materializes is a tall task, especially considering that, the biggest investments into the realization of Metaverse technology have come from existing social media and tech conglomerates who expect a significant return on their investments.

Unlike closed systems, empowered Metaverse users have full control over their creations and data within the Metaverse; revolutionizing the concept of digital ownership, often using Non-Fungible Tokens (NFTs) or similar technology, and enabling users to possess and trade digital items with true ownership rights. Additionally, in the case of virtual real estate and the virtual economy they facilitate, the investments made by users onto their permissionless assets are permanent, and no entity can solely exert control over these assets, allowing

individuals to fully participate, express themselves, and benefit from the value they create for the network, forever.

However, primarily due to technical limitations, such global, open, permissionless systems do not have the current technical capability to realize society's long term expectations and potential permissionless forms. This is true throughout established permissionless use cases, where user experiences break down once utilization rates grow. As such, the idea of an open Metaverse remains a target; akin to a north star, which aims to lead the emergence of Virtual Worlds into an interoperable, free and dynamic companion to the physical realm.

In recent years, legitimate strides toward this north star have been taken, often by the same industry incumbents that may ultimately seek to produce closed and permissioned Metaverse alternatives that they plan to monetize. Following the description of key open Metaverse features, an exploration on the alternatives will be produced.

Key Principles of an Open, Permissionless Metaverse

- **Decentralized Control**: A wide variety of users, from individuals to companies, have control over the underlying structure (code base) being the foundation for the Metaverse being built on, avoiding the need for a central authority.
- **Open-Source Technology**: Leveraging the power of open-source technology, allowing creators to focus on their original ideas and innovations while at the same time providing full transparency of the mechanics of the code base.
- **Self-Sovereign Identity**: Users can control and manage their own identity, giving them greater control over their virtual experiences.
- **Self-sovereign property rights**: Users have full control over their Metaverse assets and content.
- **User-Focused**: Designed to put users in control, whether they are creators who want to own the results of their work or explorers seeking the best virtual experiences.
- **Incentives for Participation**: Provides coins and digital assets as incentives for participation, making the network more efficient and effective.
- **Permissionless:** No centralized entity or group of people controls access to the Metaverse.
- **Interoperability:** The feature of interoperability is twofold. On the one hand are the hardware devices giving access to and enabling the full scope of features within the Metaverse. While at the same time, code standards should enable moving digital assets and content between multiple digital worlds and/or building on top of them.

An Open, Permissionless Metaverse represents a new era of virtual freedom, where users have control and can participate in creating a decentralized, open, and accessible virtual world.

2.1.3 What is the Closed/Permissioned Metaverse?

A closed Metaverse refers to a virtual environment or digital space that is controlled and operated by a limited number of entities or organizations. Access, governance, and decision-making power are tightly controlled, often by a single company or a small group of dominant players. Users within a closed Metaverse typically have limited or no ownership rights, restricted mobility between platforms, and limited interoperability with other Metaverses or virtual worlds.

The control over the development, rules, and economy of the virtual space lies predominantly in the hands of these controlling entities. These entities may impose restrictions on user-generated content, limit the ability to transfer assets or data, and exercise strict control over monetization and transactions within the Metaverse. In a permissioned Metaverse, users must typically register or be invited to participate, and may be subject to various rules and restrictions while within this virtual environment. These rules might include prohibitions on certain types of behavior, requirements for certain levels of participation or engagement, or limitations on the types of content that can be created or shared.

It is important to note that permissioned metaverses are valuable sub-niches of the Metaverse; often used in business, education, and other contexts where security, privacy, and control are important concerns. For example, a company might use a permissioned metaverse to facilitate virtual meetings, training sessions, or product demonstrations, while limiting access to only authorized employees or clients. In the case of collaborating or co-producing companies, the term industrial metaverse is used for approaches enabling communication with physical objects, processes, and environments. The industrial metaverse focuses on use cases in companies geared towards real-world challenges and business requirements. It enables a range of use cases for different industries ranging from simulated construction work over maintenance and repair, virtual product testing and digital twin management.

Overall, permissioned metaverses offer a way to create virtual environments that are tailored to specific needs and goals, while also providing a high degree of control and security over who can participate and how.

2.2 Metaverse History and Timeline

The metaverse is a term that has existed for the past 30 years. It is also a technology that encampases a myriad of subsectoral technical innovations, all of which play an important part in its development. Below is a brief timeline and expected growth for the industry:

METAVERSE HISTORY AND TIMELINE	
Years	**Description**
1992	Although the concept of an alternate virtual reality existed earlier, the word 'Metaverse' was first coined by the writer Neal Stephenson in 1992. He used it to describe a digital world in his novel Snow Crash, where people interact and buy things like real estate
2003	Linden Lab launched **Second Life**, an online virtual world that allows users to create their own avatars and interact with others
2006	**Roblox**, an online game platform, was launched. Players can customize their avatars, buy and sell virtual items, and interact with others.
2012	Oculus would take a big step towards enabling the Metaverse when it crowdfunded US$2.5mn in 2012. The company was acquired by Facebook two years later before releasing the Rift, the world's first virtual reality headset made widely available to consumers, in 2016
2015	Decentraland launches a virtual world platform built on blockchain technology
2018	Cline was adapted into a film which introduced the concept of the Metaverse. Fortnite nets Epic Games $3billion profit per year.
2020	NVIDIA launches Omniverse a platform for industrial applications By 2020, manufacturers were shipping more than 5mn shipments of virtual reality (VR) and augmented reality (AR) headsets per year. There is a consensus that, although the Metaverse could be accessed in a number of ways, consumers will need an immersive headset to take full advantage.
2021	Facebook positioned itself to capitalize on the future of the Metaverse by rebranding its parent company as Meta. It also announced it would invest US$10bn and hire 10,000 in Europe to build out a Metaverse. Microsoft launches Mesh as a Metaverse platform service. Seoul releases its 5-year Metaverse plan. Barbados announces its plan for a Metaverse embassy.
2022	The word 'Metaverse' came runner-up in a public vote to determine the Oxford English Dictionary's word of the year – on its 30th birthday, no less. The word became one of the hottest fintech buzzwords of the year

	and investors spent millions acquiring virtual real estate in the Metaverse. Dubai launches its Metaverse strategy. Shanghai developed an action plan on Metaverse. Tuvalu, a Pacific Island, plans to replicate itself in the Metaverse world and NVIDIA collaborates with Siemens to industrial Metaverse.
2023	Several UN agencies release research and pilot projects of the Metaverse.
2030	According to analysts, the global Metaverse industry will be worth nearly US$100bn by 2030 – almost 50 times what it's worth today. But adoption will be defined largely by the number of people buying VR headsets. In the US alone, around 15% of people own a VR headset today, compared with 53% for tablet computers.

2.3 Key Metaverse Features and Activities

Existing metaverse innovations have given rise to a few interesting features and activities. This section aims to introduce a few of these features and activities.

2.3.1 Inclusion of avatars

The creation of digital avatars, often referred to as digital twins, is a cornerstone of the concept in the Metaverse and serves as a distinctive medium for personal emotional and sentimental expression. These digital representations give each individual a unique digital identity, which can range from static images to animated forms. Avatars in the Metaverse are not simply digital embodiments but offer the possibility of profound self-expression. They can be designed to mirror one's physical appearance, embody the likeness of an admired celebrity, or display entirely unique designs that transcend the boundaries of physical reality.

The gamification aspect is introduced in the Metaverse through the customizable nature of these avatars, which increases user engagement and contributes to a dynamic interactive environment. This customizability allows users to continuously adapt their digital representations, allowing these avatars to evolve alongside their real-life counterparts. Freedom of expression is a core principle of the open Metaverse.

From a technological perspective, avatars are often operated via various human-computer interaction (HCI) mechanisms, including keyboards, joysticks, mouse control and dedicated HCI devices. This interaction paradigm emphasizes the symbiotic relationship between the user and their digital persona.

In addition, the level of realism that these avatars embody plays a crucial role in the user experience. Lifelike avatars have the potential to significantly improve immersion in the digital space for both the avatars and their interaction partners. This increased realism of avatars can lead to more engaging and authentic experiences in the Metaverse, bridging the gap between virtual and physical reality and enriching the overall quality of digital interactions.

2.3.2 Blockchain-based transactions

Blockchain will become a key component of the Metaverse since it secures users' virtual assets and offers digital proof of ownership. Data volume, value, and the need of security and dependability are all increasing in the Metaverse. Blockchain skills and technology are necessary to assure data validity in the Metaverse, and artificial intelligence is used to maintain its diversity and wealth of material.

Due to the inherent problems of centralized data storage in systems such as database management systems (DBMS), the Open Metaverse concept will be incomplete without blockchain-enabled assets and transactions. Blockchain-based Metaverses enable access to any digital asset, as long as a user has internet access.

2.3.3 Virtual land (Metaverse parcels)

Virtual land in the Metaverse represents a remarkable shift in the reasoning behind digital asset acquisition. In virtual worlds, land can be acquired with digital currencies, suggesting a fusion of digital finance and digital worlds. Such virtual land is classified as non-fungible tokens (NFTs). Unlike fungible cryptocurrencies, NFTs are unique and cannot be mutually exchanged one-for-one, ensuring that each parcel of virtual Metaverse land is inherently unique and irreplaceable.

The dimensionality of these virtual properties is quantified in the form of pixels, which are the basic unit of measurement for Metaverse real estate. This unit of measurement not only indicates the size of the virtual land, but also implicitly influences its potential uses and value. The uses of these virtual estates are varied and multi-faceted and include digital storefronts, virtual gaming platforms and various forms of digital entertainment.

Importantly, the strategic importance of a virtual land plot in the Metaverse is highly dependent on its size and geographical location within the virtual environment. For example, properties located on virtual reality (VR) streets may have a higher value due to their visibility and access to virtual foot traffic, especially for advertising purposes. This correlation between location and potential use case mirrors the principles of physical real estate and underscores the nuanced parallels between the valuation and utility of virtual and physical assets in the Metaverse.

2.3.4 Immersive Experiences (AR/VR)

The Metaverse, underpinned by mixed reality and augmented/virtual reality (AR/VR) technologies, may offer experiences where the physical and virtual worlds merge seamlessly, increasing the depth and realism of user interaction. This synthesis of realities is a key factor in the growing popularity of the Metaverse. It transforms traditional forms of entertainment and interaction such as games, theater performances, concerts and even professional and educational networking into immersive, lifelike experiences.

AR and VR technologies are foundational elements of the Metaverse and serve as channels through which enhanced user experiences are delivered. These

technologies enable the creation of a hybrid environment in which the physical and digital worlds not only coexist, but also interact synchronously.

There are three critical components that are essential to the functionality of augmented reality systems in the Metaverse context. The first is the connection of physical and virtual environments, which ensures a seamless and cohesive user experience. This integration makes it possible to augment the real environment with digital overlays, creating an enriched, interactive environment.

The second component is real-time interaction, which is critical to maintaining the fluidity and responsiveness of the Metaverse experience. This aspect ensures that the user's actions and movements are immediately reflected in the virtual environment, providing an intuitive and natural interaction that resembles real-world experiences.

Finally, the realistic representation of 3D objects is crucial for immersive augmented reality experiences. This involves creating digital objects that not only look lifelike, but also behave according to the laws of physics and interactions with the environment. Such realistic renderings increase the credibility of the virtual world and make the Metaverse more interesting and convincing for its users.

Together, these components form the backbone of the AR systems in the Metaverse. They enable immersive experiences that blur the boundaries between reality and the virtual world and lay the foundation for the future of digital interaction.

2.3.5 Collaboration with artificial intelligence (AI)

As the driving force behind business research in disciplines like content analysis, self-supervised voice processing, robotic interactions, computer vision, and whole-body posture assessment, AI is vital to the Metaverse.

AI can be utilized in a variety of ways to deliver Metaverse commercial applications. AIOps, a subset of AI, employs machine learning to assist businesses in managing their IT infrastructure, and this technology will soon be relevant to Metaverse systems. Furthermore, AI-powered chatbots are gaining popularity among corporations. In the Metaverse, bots with lifelike avatars can be employed for a variety of reasons, including sales, marketing, customer service and non-commercial applications.

2.3.6 Decentralized Autonomous Organizations (DAOs) Governance

A decentralized autonomous organization (DAO) functions as a governance entity similar to a traditional council or committee but using the principles of blockchain technology and smart contracts. The core of a DAO lies in its decentralized and democratic decision-making process, which is facilitated by these advanced technological means.In the area of DAO governance, a key component is the treasury wallet, which serves as a financial reservoir for the organization. Treasury governance is crucial; it determines the allocation and utilization of resources within the DAO ecosystem to achieve the DAO's mission.

Another fundamental principle of DAOs is the emphasis on inclusive and participatory stakeholdership. Every decision within a DAO is subject to a

structured process of proposals and voting. This ensures that all members of the organization, regardless of their position or investment, have the opportunity to contribute to the governance process. Such a system is designed to democratize decision-making and avoid the centralization of power that is often found in traditional organizational structures.

In summary, a DAO represents a move away from traditional hierarchical governance models towards a more decentralized, transparent and democratic system. Its reliance on blockchain technology and smart contracts for decision-making and resource management makes it an innovative and potentially transformative model for governance in the digital age, particularly in the context of the Metaverse.

2.3.7 Application of Human-Computer Interface (HCI) Technology

The use of HCI in the development of the Metaverse, specifically how to integrate human behaviors into the virtual environment, is important to reaching the long term vision of a fully immersive and accessible Metaverse. Through this technology, a human and a computer exchange information to participate in specific activities through continuously seamless processes, currently focused on typing and voice, but soon through non-verbal methods. The most significant benefit of human-computer interaction is that it helps onboard groups that would initially require a lot of formal training and instruction on how to engage with Metaverse systems.

2.4 Metaverse Platform Examples

Consider the following platforms that are bringing this vision and concept of the Metaverse into reality:

2.4.1 Decentraland

Decentraland is a decentralized virtual world built on the Ethereum blockchain, where users can buy, sell, and develop parcels of virtual land called LAND. Each LAND parcel is represented as a non-fungible token (NFT), providing digital ownership and control to its holder. Within Decentraland, users have the freedom to create and monetize interactive experiences, art installations, and virtual businesses on their LAND parcels. To facilitate these transactions, Decentraland's utility token, MANA, can be used as an on-chain currency. Decentraland's open and decentralized platform enables users to explore, socialize, and engage with a diverse range of virtual content, fostering a dynamic and immersive metaverse experience.

2.4.2 The Sandbox

The Sandbox is a blockchain-based virtual world where users can create, own, and earn digital assets and experiences. It offers intuitive creation tools that allow users to design and build their own voxel-based games, experiences, and virtual real estate. Creators within The Sandbox can earn through the sale of non-fungible tokens (NFTs) and virtual goods on secondary marketplaces. The Sandbox fosters a vibrant community of creators, artists, and gamers, empowering users to unleash their creativity and participate in a decentralized virtual economy.

2.4.3 Bloktopia

Bloktopia uses virtual reality to present consumers with an immersive experience. It is a virtual 21-story skyscraper that represents the current 21 million Bitcoins in circulation. It provides a number of revenue-generating options through innovative virtual experiences. Users can customize their avatars, participate in numerous activities, learn about cryptocurrency, and purchase virtual real estate in the skyscraper. Using the platform's builder tool, you can also use this real estate to create artwork, games, sequences, and other things.

2.4.4 Worlds of Meta Horizon

Users can interact, conduct business meetings, explore the virtual world, participate in virtual activities, and play games on Horizon Worlds. Horizon Worlds is one of Meta's virtual reality social apps. Unlike previous examples, blockchain technology is not employed in the Horizon universe. It contains navigable VR settings as well as functional VR building pieces such as code blocks, audio, and animation effects to assist content makers. Horizons was created by Facebook (now Meta Platforms Inc.) in August 2020 as a test platform for virtual explorers with an invite-only policy.

2.4.5 Metahero

The Metahero project develops usable technology that enables users to scan real-world objects and transmit them to the Metaverse rather than a virtual domain. Its primary purpose is to use ultra-HD photogrammetric scanning technology to digitize tangible objects. With their 3D avatars, users can utilize Metahero as a conduit to begin exploring the NFT, social media, fashion, and many other elements of the Metaverse.

3. Technology of Metaverse

3.1 Metaverse Technology Layers

Similar to ISO internet standards, the Metaverse is composed of seven layers, from the infrastructure layer at the bottom (first layer), to the user experience layer of the Metaverse, as seen in the seven layers depicted in the following figure 1:

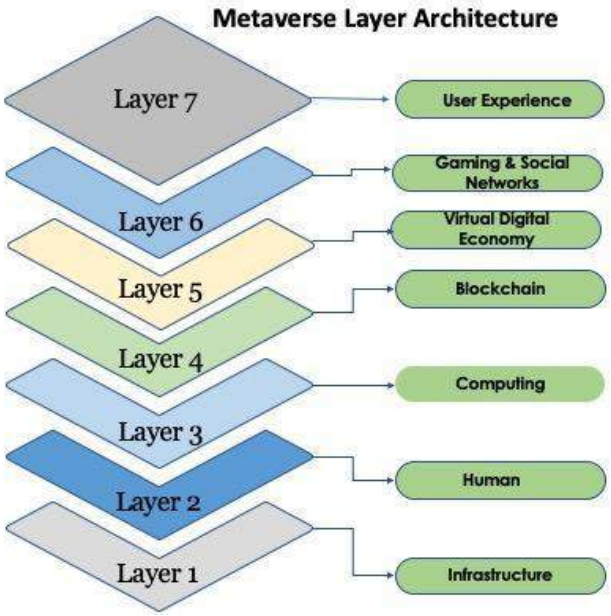


Figure 1: Metaverse Layers Architecture

This section will dive down into each layer of the Metaverse.

Layer 1: The infrastructure Layer

The infrastructure layer is the fundamental backbone for the operation of the metaverse. It is responsible for seamless connectivity, real-time interactions and a decentralized control mechanism that makes the concept of the metaverse equitable and universally accessible. The infrastructure layer includes IoT devices, Storage and 5G/6G network technologies. Because of the speed and pervasiveness of the 5G network, the blockchain transactions can be propagated much more efficiently and network bottlenecks can be reduced and thus improve the performance and scalability of blockchain. The data collected from IoT devices can be propagated to the upper layers with data privacy and sovereignty protected using decentralized identity and then empower the Metaverse digital economy. Using P2P networks can decentralize data storage and sharing, meaning the data is stored across different devices in the network, eliminating central points of control of failure. As we build the infrastructure layer, several considerations come to the forefront:

- **Scalability:** As more users join the metaverse, the infrastructure must scale to accommodate this growth without compromising performance.

- **Security:** With increased connectivity comes the challenge of security. Distributed Denial of Service (DDoS) attacks, data breaches, and other cyber threats need to be addressed proactively.

- **Sustainability**: The vast infrastructure required for the metaverse will consume significant energy. Adopting green technologies and ensuring energy-efficient operations will be crucial for its long-term sustainability.

Layer 2: The human layer

The human level of the metaverse is crucial because it focuses on the interactions, experiences and dynamics of the individuals who populate this virtual space. As the central entity in the metaverse, people dictate the direction of development, cultural norms and quality of experience. An effective human layer considers human-centered designs, accessibility, inclusivity and interpersonal dynamics. Digital identities allow users to interact, express, and establish their presence in the metaverse. They can be lifelike representations or stylized characters, embodying a user's desired persona. As we build the human layer, several considerations come to the forefront:

- **Representation**: Ensuring diverse representation in avatars, experiences and cultural elements.

- **Accessibility:** The metaverse should be accessible to people with disabilities, provide alternative methods of interaction and ensure universal design principles.

- **Mental health**: Prolonged immersion can have psychological effects. Recognizing these and offering support or guidelines can help users to navigate the Metaverse in a healthy way.

Layer 3: The computing layer

The computing layer of the Metaverse is critical as it provides the computing power and infrastructure required to handle the vast and complicated digital environments, simulations and user interactions. By providing the necessary resources and platforms, the compute layer ensures that the Metaverse is scalable, responsive and immersive. Diverse metaverse ecosystems require extensive computing resources such as cloud and edge computing. Cloud computing are centralized data centers that provide resources on demand and offer flexibility and scalability. Edge computing allows for processing data closer to where it is needed to reduce latency and enable real-time user interactions. Graphics-intensive environments require intensive processing capabilities such as GPUs and HPC clusters. Graphics processing units (GPUs) are specifically designed for fast image rendering and parallel processing. Their capabilities go beyond traditional gaming and enable smooth visual experiences in the metaverse.

High-Performance Computing (HPC) clusters are collections of servers that work together to deliver incredible computing power. Efficient resource allocation and provisioning is critical for sprawling metaverse platforms when we have multiple applications and environments. Different mechanisms include containers (such as

Docker) and virtual machines (VMs). Docker allows applications to be packaged with all their dependencies to ensure consistent deployment. Virtual machines provide isolated environments so that multiple Metaverse instances or applications can run simultaneously on a single physical server.

Layer 4: The blockchain layer

The blockchain layer in the metaverse comprises the fundamental decentralized ledger technology that provides security, trust and interoperability for the myriad systems that operate in these sprawling digital worlds. By ensuring that transactions, digital assets and user identities are secure and verifiable, blockchain technology becomes a key player for building and growing the metaverse. The use of these decentralized technologies ensures a metaverse that is not only expansive and interconnected, but also grants its users real rights of ownership and control.

Layer 5: The virtual digital economy layer

In the complex digital fabric of the metaverse, the virtual digital economic layer stands out as an essential component. This layer not only enhances user immersion by providing economic incentives and parallels to the real world, but also forms the backbone of many activities, transactions and engagements in these vast virtual environments. The idea of a digital economy within the metaverse revolves around building dynamic economic systems. These systems can mirror real-world economies or introduce entirely new paradigms thanks to the limitless potential of virtual spaces. Underpinning these economies are digital assets, currencies, marketplaces, trading mechanisms and economic policies that facilitate interactions, trade and value creation. At the heart of the virtual digital economy are digital assets and currencies. Digital assets can be anything from virtual real estate to digital art to rare in-game items. They have a quantifiable value and can be traded, leased or sold. The rise of non-fungible tokens (NFTs) demonstrates the uniqueness and ownership of digital assets and attests to their rarity and authenticity. Moreover, cryptocurrencies enable seamless transactions without geographical boundaries and without the restrictions of traditional banks.

The exchange of these assets is facilitated by specialized digital marketplaces. These platforms offer users the ability to browse, offer, buy or sell their digital possessions. Each marketplace may have its own rules, trading mechanisms and verification systems. Some are generic and offer a wide range of assets, while others specialize in niches, such as those dedicated to virtual fashion or digital art galleries.

A thriving digital economy needs structure. This is where economic policies and governance mechanisms come into play. These policies determine how assets are minted, how trade is conducted, how disputes are resolved and much more. In decentralized metaverses, governance often takes a democratic turn, with users having a say in policymaking via decentralized autonomous organizations (DAOs) or token-based voting systems.

The virtual digital economy is not without its challenges. Issues related to asset valuation, regulatory oversight, fraud prevention and ensuring equitable economic opportunities for all users are important areas to focus on. But the opportunities

offered by the digital economy are immense. Beyond just commerce, the virtual economy has the potential to transform industries, create new revenue streams and create jobs in the digital world. The Virtual Digital Economy Layer is more than just an auxiliary component of the Metaverse; it is a driving force. By integrating real economic principles with the vast possibilities of the digital realm, it offers a unique mix of opportunities and challenges. As the metaverse evolves, so will its economy, carving a niche for itself in the global economic landscape and becoming an integral part of our digital future.

Layer 6: The games and social networks layer

The Games and Social Networks layer is one of the most formative and visible aspects of the metaverse. It promises to bridge different realities and unite play and social interaction in an environment where rules can be bent, and imagination knows no bounds. This level embodies the interactive and connective fabric of the metaverse and provides both a gateway and a playground for users from all walks of life. Here, the worlds of games and social media don't just coexist – they merge, influence and feed off each other.

Unlike traditional games, the Metaverse offers a permanent world. What you do today can affect the state of the game for other players tomorrow. The narratives can be extensive and non-linear and are shaped by both the developers and the players. In the metaverse, it is conceivable to use a sword from one game in another or drive a car from a racing game through a fantasy role-playing game. This interoperability breaks the boundaries of game-specific assets. In-game assets, from avatars to weapons, could have real-world value and lead to professions such as virtual blacksmiths, real estate agents or even in-game event managers.

Layer 7: The user experience layer

In the multi-faceted world of the metaverse, the user experience layer is a cornerstone that provides users with an in-depth, interactive and personalized environment. At its core, the experience layer is designed to drive engagement and facilitate the translation of abstract digital concepts into tangible experiences that can evoke genuine emotion, provoke thought or elicit a variety of responses. The experience layer is an interplay of advanced technologies, innovative design and a deep understanding of human psychology. It seeks to transcend the limitations of screens and devices and take users headfirst into a world where experiences are as vivid, stimulating and meaningful as they are in the real world. As the metaverse expands, the experience layer will undoubtedly play a critical role in how users perceive, interact with and even shape this new digital world.

The main goal of the user experience layer is to develop an overwhelming sense of immersion so that users forget the boundary between the virtual and real worlds. This is achieved by addressing multiple senses:

- **Visual realism**: advanced graphics engines and real-time ray tracing technology bring hyper-realistic environments to life, where reflections, shadows and details mimic the natural world.

- **Haptic Feedback**: Wearable technologies, haptic gloves and suits, allow users to 'feel' virtual objects, from the texture of digital fabrics to the impact of virtual raindrops.
- **Spatial Audio**: This adds depth to the audio experience. Users can perceive the direction from which a sound is coming, be it the rustling of leaves behind them or a distant conversation to their left.

The user experience layer is dynamic and responds to the user's actions, emotions and preferences:

- **Interactive Landscapes**: Virtual environments adapt and respond to the user's actions. This can range from landscapes that change with each step to entire ecosystems that adapt based on collective user behavior.
- **Emotive avatars**: By integrating biometric data, avatars can reflect a user's real-life emotional state, fostering genuine interpersonal interactions in the digital world.
- **Personalized experiences**: AI-driven algorithms curate experiences tailored to individual preferences, from suggesting events to customizing the look of one's virtual environment.

The user experience layer is not limited to the metaverse. It is intertwined with our physical world:

- **Augmented Reality (AR):** Through devices such as smart glasses or mobile phones, the virtual and real worlds are merging. Users can see virtual information over real objects or interact with digital entities in their physical space.
- **Mixed reality (MR):** This goes one step further than AR, where users can manipulate virtual objects in real time in their real environment.

4. Use Cases of Metaverse

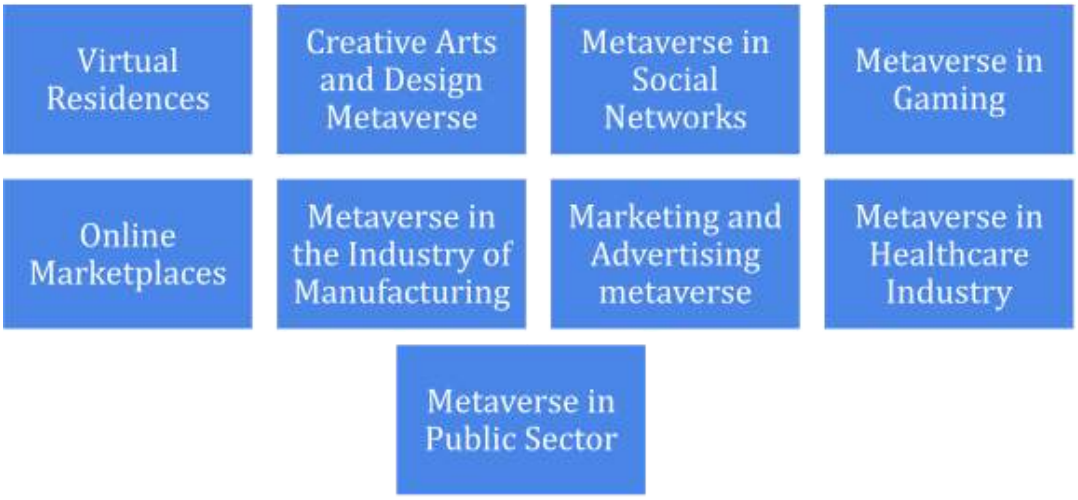


Figure 2: Highlighted Metaverse Use Cases

4.1 Metaverse and Virtual Residences

Virtual real estate refers to digital property that exists in online locations, often known as virtual worlds or metaverses. These digital goods exist in a range of shapes and sizes, with parcels of land, buildings, and avatars being the most frequent. In the most basic sense, they are pixels, however, they are more than just digital representations. They are programmable establishments in virtual reality platforms where people can mingle, play games, sell NFTs, hold meetings, attend virtual concerts, and do a variety of other social activities. An initial metaverse real estate boom occurred in the fourth quarter of 2022, when Facebook changed its name to Meta and displayed a major interest in metaverse technology. With the emergence of the metaverse, digital real estate is expected to grow and expand. The value of metaverse real estate is expected to climb at a Compound Annual Growth Rate (CAGR) of 37.2% from 2022 to 2028 as its popularity grows.

As with real estate investments, these digitized chunks of land represent a profitable prospect. Metaverse properties, like real world properties, can be developed, flipped, or leased. Indeed, metaverse real estate has a variety of applications. Some members believe that metaverse will herald big changes, or additions, in the real estate industry, by:

- Making real estate available to a broader range of investors, splitting an investment into hybrid, physical-only and virtual-only investments. Additional optional unlocks investment opportunities to market participants that would not be able to participate in traditional real estate investments.
- Facilitating innovative real-world activities that combine digital and physical through augmented reality. The possibility of hybrid-world activities,

combining the metaverse with physical location, can enhance trade shows, exhibitions, weddings, and other social gatherings.

It must be noted, however, that risks do exist. Lack of past usage, property price volatility and concerns about privacy and security may contribute to market sentiment swings, which in turn may produce under-performing assets. Before becoming involved in the industry, ensure deep understanding.

In any case, the metaverse illuminates the real estate industry in entirely new ways. It has proven to be quite beneficial thus far, but like with anything new, only time will tell how this new technology can truly embed itself on Real Estate.

Highlighted Blockchain-based Metaverses: The Sandbox, Decentraland, Illuvium.

4.2 Creative Arts and Design Metaverse

When measuring creative activity on the Metaverse, INATBA consulted the Metaverse Creativitypeer-reviewed journal. The journal investigates creativity in user-created online virtual worlds, like Second Life. While such research work measures primarily artistic activity, it may also encompass outputs of other design disciplines, such as fashion and object design, landscape design, and virtual architecture, all of which are expected features of the Metaverse.

With that in mind, there are several important advantages to being a creator on the metaverse. These benefits are:

Collaboration and connection driving digitalization

Global and flexible social connections are at the heart of the Metaverse's appeal. Connectivity and cooperation are essential for creatives, and the digital canvas provided by the metaverse will become three-dimensional and exceedingly social as artists cooperate more effectively and quickly, remixing each other's work.

Consider the immersive Van Gogh exhibits. Through Metaverse technology, participants can see each brush stroke, in 3D, of The Starry Night on either a projector screen or through augmented reality goggles, adding fresh meaning and depth to the art piece. Imagine diving into the layers of a painting and touching the bumps in the canvas, hearing the brush strokes and crickets sing, and seeing beyond the canvas into the actual environment experienced by the artist. 3D activations have the ability to bring art to life in ways that exceed our greatest dreams.

Furthermore, in the metaverse, recontextualizing content will become the norm, with avatars (electronic pictures commonly referred to as PFPs and used online) portraying an alternative human identity. Avatars will become a part of the overall metaverse-based society, acting as both a standalone piece and as a symbol of the times; a glimpse inside your broader, all-encompassing online identity. Identity flexibility will become an important part of how people engage with each other on the metaverse. With new ways to personalize personal virtual reality settings, avatars, and other features, there are few limitations on how artistic creation can evolve.

Such possibilities go beyond visual art. The metaverse has already helped create communities focused on movie production, script and book authorship, fanfiction implementations that were inspired by popular culture and more. A permanent location on the Metaverse can establish a self-fulfilling circle where creative enterprises can create cycles of community source IP that will further expand the basis of the creative endeavor. A book, a movie or anything else, can become a phenomenon, through metaverse-first community initiatives.

As the social environments gradually become a creative canvas, artists and creators will face new challenges in integrating both physical and digital worlds, but also explore new possibilities of what is possible and welcomed by their audience. Systems and marketplaces in the metaverse will allow the transfer of rights through attribution models and ensure that all persons involved are properly compensated.



Figure 2: Art Show on Spacial – Metaverse Gallery

What's Next for Creativity in the Metaverse?

As the metaverse evolves, creatives can use the lessons acquired from building the original World Wide Web to reap all of the advantages that this digital realm offers. Many creatives are venturing into uncharted territory, open to discover what lies ahead for their creative endeavors, and the metaverse, which combines blockchain technology, PFP and flexible identities, as well as augmented and virtual reality, is there to help them take control of their creative future in unique, previously impossible ways.

4.3 Metaverse in Social Media

Social media have developed as the dominant social discourse platform over the past two decades. The average person now engages, transacts, and shares their interests online, connecting with other Social Media users in ways that no generations have experienced until the 2000s. The metaverse, a more immersive

and holistic experience to today's screen-facing platforms, will allow social networks to become even more immersive.

For a few experts, the Metaverse seems like the reasonable extension of social media. It introduces unmatched immersion into the equation and provides consumers with new digital experiences. Which is why existing social media incumbents are swiftly switching to a more metaverse-focused business model.

Industry giants like Facebook (now Meta), Twitter (now X), and Snapchat are leading this charge, recognizing the potential of the metaverse as the next frontier in digital interaction. Meta's ambitious rebranding and its vision for an interconnected virtual reality universe have set the tone for others to follow suit. X has been experimenting with features like Spaces and exploring NFT integration, while Snapchat has been actively developing augmented reality experiences and virtual environments through filters, a staple of their platform. TikTok's parent company, ByteDance, has expressed interest in the field of virtual reality (VR) and the metaverse too, although it stepped back its Virtual Worlds investment in 2023.

Regardless of any step backs, one thing is clear, the transformative actions of these companies underscores a collective recognition among social media companies of the metaverse's unique potential; not only in enhancing user engagement but also in reshaping the future of digital communication, commerce and even society. As the underlying technology matures, we can expect the gradual transition of many common social media components, such as collaboration, commerce, live events, and immersive experiences based on virtual and augmented reality (AR) will be combined in the Metaverse.

It will, however, take time. Risks, uncertainties and hurdles are very much real, and the Metaverse unlocks unknowns which are actively scoped by policy makers and regulators. Below is a list of risks and opportunities for Social Media expansion to the Metaverse:

OPPORTUNITIES	RISKS
Data Security: Decentralized metaverse network infrastructure creates a robust, yet public, repository of personal data, more so than what existing social media users broadcast on their profiles. Positively, innovative cryptographic technology can make these operations significantly safer than previously believed.	**Privacy Concerns:** As users immerse themselves in virtual environments, there's a heightened risk of personal data exposure and privacy breaches, especially with the collection of biometric data for avatars. This is when best practices are not followed. However best practices and standards have yet to be fully developed.
Immersive Setting: Customers can communicate with Metaverse social media network users	**Digital Addiction:** The immersive nature of the metaverse could exacerbate issues related to

while experiencing a tailored, lifelike simulation.	digital addiction and compulsive behavior, leading to negative impacts on mental health and productivity.
Compatibility and connectivity: Members can converse across social media networks since Metaverse is bidirectional, open and global.	**Security Vulnerabilities:** Virtual spaces may become targets for cyber attacks, leading to theft of virtual assets, identity fraud, and other security breaches within the metaverse.
Online Education: Many social networks were touted as a learning option during the lockdown. Students interacting with their training centers via the Metaverse social media networks can benefit from increased engagement strategies.	**Ethical Dilemmas:** The development and use of virtual avatars raise ethical questions regarding identity, representation, and consent, especially concerning issues such as virtual harassment, objectification, and cultural appropriation.

Finally, a topic that is both a risk and an opportunity is the future monetization tactics of social media platforms once Metaverse technology is fully embedded to major platforms.

The creation of a metaverse social media platform can help businesses provide fantastic benefits to their community members, such as advertising metaverse items, rare collectibles, and so on. If the social media network is linked to another NFT marketplace, it can profit from each trade started via its platform. Similarly, as more people join the metaverse social media network, advertising opportunities may expand.

However, monetization can alter incentives. The immersive nature of the metaverse can negatively impact user experience by prioritizing profit over user satisfaction, safety and access. For instance, the introduction of paid features or virtual goods may create a sense of exclusion for users who cannot afford them, widening a digital divide. Additionally, aggressive advertising within virtual environments may disrupt immersion and lead to user frustration, diminishing the quality of the overall experience.

Regulators are actively watching the Metaverse's expansion onto Social Media to identify both the potential risks to users, and to their data, while also researching effective ways to tackle such risks. Additional challenges will emerge when hardware technologies that collect biometric and other personal data from metaverse users become a mainstay in everyday households.

One thing is certain, the Metaverse will have far-reaching social ramifications. It will allow businesses to experiment with new ideas and unleash their creativity. New technologies and concepts will develop to capitalize on the underlying

behavioral alterations in the Metaverse. Social media will evolve from two to three dimensions, and online communication will become more immersive, allowing us to engage with family and friends all across the world in whole new ways.

4.4 Metaverse in Gaming

Immersion, ownership of digital assets, and community-empowered IP creation have always been at the center of one particular industry - Gaming.

Like with social media, the arts and finance, the gaming industry is embracing the Metaverse as the way of the future. The sub-niche of metaverse gaming has already emerged through major gaming brands, like Fortnite, where social gatherings have become a key celebratory experience for their global community. But this is only the start. With a projected $6.077 billions in annual revenue by 2027, Metaverse is expected to be used by 73% of the retail gaming market.

For many, video games are already a part of the Metaverse. A big online community in which you can play games and meet new people is certainly one of the easiest ways people can engage with the Metaverse. Virtual reality and virtual identity have always intrigued gamers and game developers.

However, are we there yet? Many argue that the primary distinction between virtual reality games and traditional video games is that virtual reality games go beyond the screen and into a 3D virtual reality environment, where a player can observe their surroundings in 360 degrees, "touching" objects and moving with a realistic sense of perception. Such games do exist, but they are still a single digit percentage (roughly 20,7bn USD) compared to the global video gaming market (roughly 246bn USD).

A hybrid approach, where the gaming experience is still outside of the Metaverse, but the community engagement and social connections creation aspects of the Metaverse exist, may be the most accurate representation of the current implementation of the Metaverse within Gaming. However, the adoption of the Metaverse by the gaming industry will only increase.

In recent years, the metaverse has attracted significant investment from game companies, tech heavyweights, and venture capitalists alike. Decentraland is one of the first companies to actively try to build a metaverse for multiplayer gaming. Sandbox is a video game that uses the metaverse to allow you to play, develop, own, and control a virtual environment. And Epic Games, mostly known for Fortnite, has already produced the aforementioned breakthroughs of community creation through their platforms non-gaming activities, notably through Travis Scott's virtual reality concert in 2020 which set the stage of what is possible for online gaming platforms, while also generating 20m USD in profits.

In the future, metaverse gaming will likely allow players to monetize their in-game assets and activities. NFT-based games are a good initial indicator of where the industry may be heading. Axis Infinity is a decentralized game employing the Play-to-Earn model. Play-to-Earn model is a blockchain game model where players earn assets in the form of tokens or other rewards that can be used in the game or traded in the open market. Axis Infinity is an RPG game that allowed players to mint and exchange playable NFTs (AXS tokens) on its platform, had

been a major source of income for gamers based in the Philippines in 2021 during the pandemic COVID-19, while other platforms, including Alien Worlds, Splinterlands, Farmers World, and so on, are expanding on the gaming experience through monetized in-game assets.

Although the opportunity to unlock tremendous economic value is there, currently, there are major fluctuations on the value and usage of these games, where bad in-game economics and an unhealthy reliance on revenue making often outweighs the fun of playing the game. Ultimately, it only takes only a few incumbents to implement, alter and improve in-game tokenomics until a golden balance is found, and the next generation of gamers can earn while playing their favorite games. To this end, countless Metaverse games have been launched by various gaming titans where such explorations are being tested across multiple games.



Figure 3: Axie Infinity – where each character is an exchangeable NFT

Roblox, a game development system and online game platform that allows players to create their own worlds and games within the greater metaverse, has been, arguably, the biggest success story thus far. Roblox has made significant strides in incorporating elements of the metaverse and enabling players to earn while playing. Some key initiatives by Roblox in this regard include their creator-focused economy, their attached Developer Exchange (DevEx) platform and the virtual economy supported by their 200+ million monthly users, who actively buy and trade in-platform assets.

In short, users can design, develop, and monetize their own games and experiences within the platform. These creators can exchange their Robux earnings for real-world currency, and players can purchase and trade virtual items, clothing, and accessories for their avatars. The platform also hosts limited-time events and collaborations with brands, offering exclusive virtual items that players can collect and trade, as well as their Roblox Metaverse Champions Program, which encourages players to participate in these in-game events and challenges.

Finally, Ubisoft, a renowned video game developer and publisher, has partnered with blockchain-based platform Enjin to introduce in-game assets with real-world value. Games like "Ghost Recon Breakpoint" and "Watch Dogs: Legion" have incorporated blockchain technology to enable players to earn and trade digital items. Enjin, itself, aims to become an infrastructure base for cross-platform gaming asset exchange and monetization, playing an integral role in the future of the Metaverse.

Overall, gaming seems to be an industry that will lead Metaverse adoption in the years to come, with existing hybrid applications paving the way for more experimentation and exploration for gaming studios.

4.5 Metaverse in Online Marketplaces

The Metaverse has already started disrupting the online marketplace business. Multiple brands are seeking to experiment on how virtually immersive experiences can augment their digital sales and growth strategies, with Nike, Gucci and IKEA leading the way. But luxury brands are not the only players in this field. Digital grocery stores, concerts and virtual assets are all in the scope of what virtual worlds can help disrupt.



Figure 4: Gucci store on the Sandbox

According to the survey conducted by Lifewire Magazine in 2022, 26% of users want to interact in the metaverse with an extraordinary virtual reality setup, and 35% are willing to pay up to $500 for a VR system. Music (46%), VR games (37%), and concert tickets (32%), are the top things they're wanting to buy right now, with 20% having previously shopped in the extended metaverse.

Onto the combination of Social and Marketplaces, Horizon Worlds is Meta's social VR gaming platform where user generated content can be created and exchanged by anyone. Meta recently announced that it has begun experimenting

with user monetization opportunities in Horizon Worlds. Similar to Roblox, selected creators can now begin creating digital objects and effects for direct sale in the virtual social arena. All of this is part of an effort to monetize the metaverse.

It is still early in the lifecycle of the Horizon Wolds platform, and it is unknown what will be offered in Meta's version of a metaverse marketplace. The capabilities, according to the company, would allow developers to "sell virtual goods and effects," such as an attachable accessory or an item that allows access to an exclusive region of a world, such as through special virtual keys. Combining this platform with Facebook's existing marketplace seems like a rational extrapolation for Meta's Metaverse future.

However, sales of digital items and luxury brands are not the only way that the Metaverse can add to the digital purchasing experience. Digital Grocery stores might become the preferred household shopping option in the near future. Researchers have created multiple platforms where consumers can review, select and purchase their groceries through VR applications. However, consumables come with plentiful requirements.

Compliance and reporting of perishable products can be augmented with the combination of frontier technologies like Supply Chain IoT and Blockchain. The FDA's Hazard Analysis and Critical Control Point (HACCP) system is already in place to address these possibilities. With the use of the above technologies it is possible to automate food condition monitoring, dramatically increase its accuracy, and speed of regulatory compliance.

Ultimately, there are plenty of potential benefits with Metaverse-based shopping, from environmental benefits (fashion material does not go to waste on the metaverse) to blockchain-enabled instant payments and authenticity checks. However, uncertainties do exist. Only future applications will shed light on the risks associated with metaverse-first retail shopping.

Planning for the Future:

Although virtual marketplaces have garnered major criticism in the past, Metaverse's popularity and utility is growing. Technology enables assets and payments can provide us with a unique future of how online shopping works. Digital twins, companion virtual clones of purchased fashion items, may be a boost to a brand's recognition, effectiveness and their ability to encourage innovation in an increasingly competitive economy, and seamlessly compliant grocery purchasing platforms may disrupt the global supermarket industry.

4.6 Metaverse in Manufacturing

An innovative application of Metaverse and Virtual World technology can be found within the industrial and manufacturing sector. Within a sector that few would expect disruptions from digital native innovations, virtual world technology has already been implemented in a more practical approach. Manufacturing businesses typically utilize Metaverse-native digital twins, which are virtual duplicates of core manufacturing functions, like an industrial production line. Businesses, like General Electric and Siemens, utilize digital twins to simulate how different alterations and scenarios might affect productivity, safety, external

environments, and a range of other factors, all without interrupting production or endangering worker safety.

The repeated use of such technologies by major industrial manufacturers, which has been taking place for years before the recent Metaverse repopularization, indicates that the effectiveness of a hybrid production process contributes to continuous innovations, proving that the adoption of the Metaverse provides an increasingly important competitive advantage. So how does Digital Twin technology work in practice, and what are the benefits and risks that come alongside its application.

A Deeper Dive into Metaverse Manufacturing

One of the most common applications for Digital Twins in manufacturing is to record and evaluate real time data from plant operations in order to suggest changes. This data can then be utilized to create new workflows and streamline business processes. The Digital Twin, when intertwined with Artificial Intelligence, becomes “wiser”, collecting and analyzing data from actual world processes, eventually developing its own recommendation of manufacturing process alterations, all through its Metaverse-based, low-risk alteration environment. Through these findings, efficient production line alterations can take place without disrupting production, benefiting tremendous innovative efficiencies.

The Metaverse can also be used to train individuals in highly specialized areas. The virtual environment allows both new and experienced operators to practice their abilities in a more realistic setting, without the risk of potentially catastrophic or costly errors. This is especially useful for employees who operate heavy machinery, which, if used wrong, might endanger workers' lives.

Several car businesses have begun to use the Metaverse to improve industrial processes. Hyundai Motor Company and Unity, a platform for developing real-time 3D content, announced a collaboration plan to design a Meta-Factory for the 2022 Consumer Electronics Show (CES). The concept involves creating a digital twin of a physical factory, which is supported by a metaverse platform, with the purpose of optimizing operations and resolving issues in a virtual area.

Metaverse Training for Industrial Production Employees

Several businesses have begun teaching their industrial workforce how to handle and maintain equipment using virtual reality headsets. The benefits are numerous; new employees get hand-on-like experience without endangering themselves or delicate, expensive equipment, and mistakes can be monitored and showcased in real-time.

JetBlue, for example, adopted a VR solution, in partnership with software firm Strivr, used to educate mechanics without the need for experimentation on real planes, where errors are not only costly and resource demanding to fix, but also potentially lethal. Strivr’s technology enables technicians to simulate interacting with a jet’s mechanical parts in a realistic, touch-enabled manner. Their software provides a near perfect training environment without the time, money, and risk associated with physical, machine-based experimentation.

Similar immersive learning technologies, partly based on the Metaverse and partially based in the physical world, combine the sense and presence of VR-supported touch with learning theory, data science, and architectural design. Participants in such training have stated that the technology improves their learning experience. These results span across industries. Verizon, for example, uses VR training packages to teach store employees how to respond in the case of a store robbery. Other programs teach warehouse workers how to load and unload trucks safely; while food manufacturing workers use metaverse-enabled technology to learn how to ensure worker safety while handling food processing equipment.

The metaverse's value for training also shines post-production, when engineers seek to calibrate their software to the desired classifications. A clear example is within the self-driving applications onto automotive vehicles. Many self-driving car manufacturers are employing 3D virtual world simulations of real-world locations to fine-tune and better train their vehicles.

Global virtual product design cooperation

An analysis of the Metaverse's impact on the industrial production process would be incomplete without addressing its impact on product design. Throughout the COVID19 pandemic, office-based work and international travel halted. As the world took shelter in accordance with world-wide health and safety guidelines, industrial design collaborations had to be postponed until a solution could be found. Teleconferencing would facilitate partial collaboration, however practical, in-person reviews of crucial manufacturing specifications would continue to be impacted by in-person restrictions.

This is where the Metaverse was used. For numerous firms, design engineers from all over the world started to collaborate remotely through virtual reality enabled Metaverse platforms. During this time, firms started to use the Internet as a collaboration-base, constructing Metaverse design rooms that employees from around the world could use to design, store and share their blueprints. The combination of 3D printing with distributed, Metaverse-based design allowed for rapid prototyping, providing a glimpse of how the future of manufacturing will emerge in the decades to come.

4.7 Marketing and Advertisements in the Metaverse

"Product, place, promotion, and price" are the four P's of marketing. As technology alters the social fabric, so do the products marketed, the places these products are advertised, the methods of promotions, and even the price of said products. In web 1.0, the goal of marketing was to create a website with contact information for a business. Then, in order to tailor the user's experience, Web 2.0 began linking people and gathering their search history. Web 3.0 now offers a more immersive experience. Tech is changing the world, and so do best-in-glass marketing tactics. A proper mix of the four P's continues to be critical in the Metaverse.

The vast amount of technical innovation and access brought forth by the Metaverse has undoubtedly created a plethora of new methods to reach and convert new clients. For marketeers, this makes sense. The Metaverse is an example of a social innovation, akin to social media. It is an innovation focused on

transforming the way people interact with each other and with businesses. As such, one of the main areas of focus for advertisers and marketers is Metaverse-enabled advertising and community development.

By first analyzing the benefits of the Metaverse for marketing, and then examining the myriad of advertising opportunities made available through a more immersive digital realm, this section identifies various techniques and experiments conducted by existing brands and companies on Metaverse advertising. These examples also provide a glimpse of the future of marketing strategies within the Metaverse.

Importance of the Metaverse in Marketing:

To most accounts, the Metaverse perfectly aligns with marketing. A fully functional Metaverse, while still a few years away, would include a range of technologies such as 3D avatars, AR, VR, and audiovisual elements. Among the activities offered in this future Metaverse include shopping, asset trading, networking, and the creation of phygital, hybrid of physical and digital, experiences.

The following Metaverse features indicate how advertising can benefit through the expansion of Virtual Worlds:

Continuously Operational: The metaverse remains operational after you leave the platform, and the persistent environment does not pause. All platform actions are perpetual.

Real-time Operations: The metaverse connects users and businesses in real-world time, allowing for direct connection with the target audience.

No Creative Restrictions: The promise of limitless creative freedom is one of the most noteworthy elements of Metaverse advertising samples. Participants are not limited to physical limitations, resources and costs, providing an ideal playground for branding experimentation.

User-Generated Content (UGC): Importantly, direct engagement and creative freedom incentivizes the creation of user-generated materials. Proper metaverse advertising can motivate client communities to participate in the creation of content that can further the business interest of a brand while ensuring consumer excitement and familiality.

Metaverse-based Marketing Developments:

Here are some instances of how brands could use the Metaverse to promote themselves.

Metaverse-centered advertising, at present, can be found primarily in online games such as Fortnite, Minecraft, Animal Crossing, and Roblox. Other notable examples, such as Decentraland and Sandbox, indicate significant chances for the future.

Many brands have created branded avatars and venues on these gaming platforms. In addition, many have replicated their services within virtual surroundings in online platforms and games. Interestingly, when it comes to games, rather than disrupting gamers' experiences, brands have merged their

brands with in-game environments and tournaments. Some of the most popular online games for brand insertions, currently, are Fortnite and Animal Crossing.

Verizon has also produced a few well-known examples of Metaverse advertising. By bringing the Super Bowl onto Fortnite, the brand gave gamers the opportunity to meet, interact and play with NFL player avatars. Alternatively, Venus, a Procter & Gamble women's razor brand, created realistic character skins within the Animal Crossing universe. Hellmann's Mayonnaise also engaged with Animal Crossing by creating its own branded island within the Animal Crossing map.

Digital Avatar Offerings

Avatars are a crucial feature of the Metaverse. Consequently, they may play a major role in future advertising campaigns. Avatars, which have existed as part of the internet for nearly a decade, are virtual representations of our physical identities. Brands that are able to produce avatar options that resonate with their audiences and communities have the opportunity to offer these branded character skins and accessories through a public market.

Gucci was among the first companies to capitalize on this trend, launching a digital range of its signature clothing on Roblox. Gucci collaborated with avatar maker Zepeto and integrated the SOK of another avatar builder, Genies, into its app. Many more well-known luxury brands, such as Balenciaga and Louis Vuitton, are also developing digital assets for in-game sales. These brands are creating their own branded in-game maps and environments, producing limited-edition NFT collections alongside their branded Metaverse setting. NFT holders enjoy special privileges in these environments.

Large-Scale Participatory Live Events

Events are also a big trend within these Gaming Metaverses. Massive Interactive Live Events, or MILEs, use a single simulation to gather a large number of people on a single platform for a concert, tournament or any other social activity. MILEs can be a live event or pre-designed situations that expand on the game's storyline and overall experience. A well known example is the aforementioned concert by Travis Scott, an American rapper who performed live in front of about 72.3 million Fortnite gamers in 2020. Such events can act as catalysts for branded virtual world content.

Ultimately, these are only a few, early stage examples of how marketers have used Metaverse-based virtual real estate and personalities to create an organic advertising campaign that resonates, and expands, their target audience.

Advertising Opportunities in the Metaverse

The Metaverse's various characteristics suggest that it is a viable advertising medium. The metaverse is always online, runs in real time, has its own independent creative economy, and, most importantly, is user driven. Early indications seem to demonstrate that the technology can be quite beneficial for the next generation of virtual marketing techniques.

4.8 Metaverse in the Healthcare Industry

Interestingly, the Metaverse may be an excellent tool in the healthcare industry for training, empowering, and assisting patients and clinicians. These findings are shared by Precedence Research, which stated that the healthcare metaverse market will be worth USD 6.85 billion in 2027 and USD 72.70 billion by 2030, growing at a 29.89% CAGR from 2022 to 2030.

The Metaverse's contribution to the healthcare revolution includes the synergetic adoption of numerous emerging technologies, namely AI, VR, AR, the Internet of Medical Devices, intelligent cloud, edge and quantum computing, and robotics. Augmented reality, in particular, seems poised to change patient care experiences.

Complex surgeries will benefit the most. The impact is expected to be similar to highly precise surgical procedures which are exceedingly facilitated, or even fully conducted, by robotics. AR, Metaverse-based infographic additions are expected to be present in multiple surgeries of the future. Already, virtual reality is used by doctors to instruct delicate movements during important parts of a surgical procedure, while collecting real-life data that can be used for future training purposes.

North America may maintain its dominance in Metaverse health applications due to the rapid expansion of healthcare infrastructure that uses digital technologies. The region's high concentration of Metaverse-focused firms, quick growth of healthcare infrastructure, absorption of AR and VR platforms into the healthcare industry, greater investment in AR goods and services, and breakthroughs in software and hardware are all contributing factors to this expectation.

For psychological healing, the metaverse can help address phobias, anxiety disorders and PTSD. The connectivity of Virtual World platform can ensure patient connectivity with their physiological supporters, while providing a prime environment for addressing traumatic scenarios and memories. Ultimately, in both psychological and surgical matters, the Metaverse can provide an avenue for innovative, yet effective treatments. This space is still ripe for additional experimentation and applications, and it is a zone of high interest for both the medical industry and regulators, since it combines multiple delicate functions.

4.9 Metaverse in the Public Sector

Governments and public institutions can leverage the Metaverse to enhance service delivery, improve citizen engagement, and optimize urban planning. For instance, public services like health care, education, and social services can be delivered through immersive virtual environments, providing accessible and inclusive services to individuals irrespective of their geographic location. This can be particularly beneficial for remote and underserved communities, ensuring equitable access to essential services.

Citizen engagement can also be revolutionized through the Metaverse. Virtual town halls and public forums can allow for more interactive and participatory forms of governance. Residents can attend and participate in these virtual gatherings from anywhere, encouraging broader involvement in local

decision-making processes. Several governments around the world have begun to explore and implement metaverse applications, often as part of their broader digital transformation strategies. Smaller jurisdictions have also started exploring metaverse applications, often driven by unique challenges such as climate change and limited resources.

Here are a few examples:

- **South Korea**

South Korea is a notable pioneer in the adoption of metaverse technologies in the public sector. The Seoul Metropolitan Government launched its "Metaverse Seoul" project, aiming to create a virtual communication ecosystem for public services by 2026. This initiative includes virtual public offices where citizens can interact with officials, attend meetings, and access various municipal services in a virtual environment. It also plans to host cultural events and educational programs within the metaverse, enhancing civic engagement and accessibility.

- **United Arab Emirates**

Dubai has been actively integrating metaverse technologies through its "Dubai Metaverse Strategy," which seeks to make Dubai a leading hub in the virtual world. The strategy involves the development of a virtual reality (VR) training platform for government employees, providing them with immersive training experiences to improve their skills and efficiency. Additionally, the Dubai Electricity and Water Authority (DEWA) has launched a customer service center in the metaverse, allowing users to interact with the authority in a virtual setting.

- **Tuvalu**

Tuvalu, a small Pacific island nation facing existential threats from climate change and rising sea levels, has turned to the metaverse as part of its survival strategy. In 2022, the Tuvaluan government announced plans to create a digital twin of the entire country in the metaverse. This initiative, known as the "Future Now Project," aims to preserve Tuvalu's culture, heritage, and sovereignty digitally. By creating a virtual version of Tuvalu, the government seeks to ensure that its cultural identity and national presence endure, even if the physical islands become uninhabitable.

- **Barbados**

Another small jurisdiction leveraging the metaverse is Barbados. In 2021, Barbados became the first sovereign nation to establish an embassy in the metaverse. The Barbadian government partnered with Decentraland, a decentralized virtual reality platform, to create this virtual embassy. The initiative aims to facilitate diplomatic and consular services, promote tourism, and provide a virtual space for international engagement. This innovative approach allows Barbados to expand its global presence and connectivity despite its geographical limitations.

These examples illustrate the growing interest and investment in metaverse technologies by governments worldwide, aiming to enhance public service delivery, citizen engagement, and urban planning through immersive virtual environments. In addition, smaller jurisdictions also benefit by utilizing the Metaverse, enhancing global connectivity, and preserving their cultural heritage.

5. Regulatory Analysis

5.1 Existing Work on Standards

Currently, there are no specific regulations in place for the Metaverse. However, there are existing laws and regulations that may apply to certain aspects of the Metaverse, such as data protection and privacy laws, intellectual property laws, and criminal laws.

For example, many countries have data protection and privacy laws that apply to the collection, storage, and use of personal data, which could apply to the collection and use of data in the Metaverse. Intellectual property laws, such as copyright and trademark laws, could and should also apply to the creation and use of virtual content and assets in the Metaverse. Criminal laws could be applied to certain activities in the Metaverse that are illegal in the physical world, such as virtual sexual offenses or the virtual sale of drugs and weapons.

However, the application of existing laws onto the Metaverse may be complex and challenging, as the virtual environment of the Metaverse operates differently from the physical and Web2.0 digital worlds. As the Metaverse continues to evolve and expand, new standards, regulations and laws will be developed to address the unique challenges and opportunities presented by this technology.

As of today, there are a number of organizations working on Metaverse focused standards. These include the following:

5.1.1 Metaverse Standards Forum (MSF) Standard

The Metaverse Standards Forum (MSF), with 2400 member organizations as of March 2023, states that they provide a venue for cooperation between standards organizations and companies to foster the development of interoperability standards for an open and inclusive Metaverse, and accelerate their development and deployment through pragmatic, action-based projects. Notably, the MSF focuses on implementation prototyping, hackathons, and open-source tooling to accelerate the testing and adoption of standards, while also developing consistent terminology and deployment guidelines.

The activities of the MSF are directed by the needs and interests of its members and may involve diverse technology domains, including but not limited to:

- Interactive 3D assets and photorealistic rendering
- Human interface and interaction paradigms including AR, VR and XR
- User created content
- Avatars, identity management and privacy
- Financial transactions
- IOT and digital twins
- Geospatial systems

The MSF establishes a pipeline of exploratory and domain working groups that meet regularly. Some of these groups are:

The Working Groups as of March 2023 include:

- 3D Asset Interoperability using USD and glTF
- Digital Asset Management
- Metaverse Standards Register
- Real/Virtual World Integration

The Exploratory Groups currently include:

- Digital Fashion Wearables for Avatars
- Interoperable Characters/Avatars
- Network Requirements and Capabilities
- Privacy, Cybersecurity & Identity'
- Technical Interoperability and End-User Troubleshooting

5.1.2 X Reality Safety Intelligence (XRSI) Standard

XR Safety Intelligence (XRSI) is a 501(c)(3) global non-profit Standards Developing Organization (SDO) that offers advisory services to promote privacy, security, and ethics with a mission to help build safe and inclusive experiences. Headquartered in the San Francisco Bay Area, XRSI currently advises over 30 governments and has over 200 diverse and multidisciplinary advisors from around the globe. XRSI is one of the industry's first global efforts to set standards, and is uniquely positioned to provide impartial, practical information about Extended Reality (XR), emerging technologies and Metaverse-related risks and opportunities to individuals, corporations, universities, government agencies, and other organizations worldwide.

XRSI launched the first novel XRSI Privacy Framework for the XR domain to address the Privacy and Safety Issues in the Metaverse. XRSI has developed the immersive technology standards for accessibility, ethics, inclusion and safety. XRSI is currently working on Medical XR and Child Safety frameworks for addressing Privacy and Safety Issues in the Metaverse.

Since 2019, XRSI has created various programs focusing on the most critical aspects of the immersive domain, such as Medical XR (Medical XR Advisory Council), Child Safety (Child Safety Initiative), Diversity and Inclusion (CyberXR Coalition), Trustworthy Media Platform (Ready Hacker One), and the Metaverse Reality Check (The MRC), an oversight board by and for the citizens. XRSI is a member of the World Economic Forum (WEF) Global Coalition of Digital Safety as well as part of the Metaverse Initiative by WEF. XRSI provides contributions and oversight to several key open-source efforts pertaining to Metaverse-related technologies, including International Telecommunication Union (ITU), The Metaverse Standard Forum and Responsible Metaverse Alliance.

5.2 Competition Law

Like any new economic activity that invites the involvement of BigTech, the Metaverse quickly raised concerns of anti-competitive conduct from large tech incumbents. Part of the initial unease was the prospect that competition law may not be well equipped to deal with such novel and innovative economic activities as the Metaverse. However, competition law is, by nature, extremely adaptable and widely relevant, as it applies horizontally across all markets and all economic actors, and its laws and concepts are abstract so that they can be ported into any economic context and any economic activity. This means that existing competition law remains applicable in the Metaverse, and it already has the tools to deal with anticompetitive conduct in the Metaverse. Some adaptations will surely be needed, but for the most part, the known offenses, and particularly recent ones that were developed for platform markets (e.g. self-preferencing, abuse of dominance in ecosystems), can already provide initial coverage.

Competition law enforcement generally falls under three areas: monopolization/abuse of dominance, cartels/anti-competitive agreements, and merger control. Monopolization cases can concern either excessively high or low prices, or other methods that exclude rivals from the market. It is less likely to see excessive pricing abuses in the Metaverse at this stage, because players in new markets (such as the Metaverse) generally try to subsidize users and developers in order to expand the market, and so any pricing decisions are initially likely to be user and developer friendly. While below-cost pricing, on the other hand, is possible (often in the form of even free products or services), true sustained and unjustified offenses of that sort are exceedingly rare in digital markets, and the Metaverse will likely be no exception.

One area that might require elevated attention is the buildup of market power due to entry barriers and barriers to switching and interoperability. Depending on the infrastructure requirements of the metaverse (such as Content Delivery Networks, ecosystem of devices), as well as the difficulty to achieve regulatory compliance, it may be challenging for disruptors to enter the segments of the metaverse market. Moreover, the interface between users and the metaverse (e.g. VR headsets, gestures etc) can differ significantly from one metaverse version to another making switching potentially harder. This is true for users, but, more importantly, it can be true for developers who cannot afford to create duplicate versions of their apps for different metaverses with materially different interfaces.

Other methods of excluding rivals from the market, such as tying of products/services together, refusal to deal with rivals, self-preferencing and others, can be expected (especially in the form of walled gardens erected by large established companies), but as mentioned, the existing rules and standards of competition law already provide a capable analytical framework. Some adaptations will be necessary, but this is true for any new market.

When it comes to anticompetitive agreements in the metaverse, the central role of the blockchain has invited some cartelization speculation The idea is that, since blockchain is inherently cooperative, this will invite collusion among participants. The paradox here is that blockchain is essentially a permanent immutable record of transactions, which cartelists would want to avoid as it serves as evidence of

their illicit activity. The world of commerce is, of course, full of agreements that do not amount to cartels, but may still be deemed anticompetitive. While this is likely, for such agreements to be able to harm the competitive process a certain degree of market power (so that effects will be non-negligible) and large differences in negotiation power are usually essential. With relatively low entry barriers and a high degree of differentiation, fragmentation, and market experimentation, the conditions for anticompetitive agreements that can distort the competitive process in the Metaverse may not be ripe yet. Certain agreements that aim at co-developing standards or committing to conduct principles, especially in nascent markets adopting new technologies such as the Metaverse, while they can cross into anti-competitive territory, are usually seen as welfare-enhancing and are unlikely to be challenged.

A last question arises on the control of mergers and acquisitions that will inevitably take place in the Metaverse markets. Competition authorities are better equipped to assess M&A activity in digital markets even compared to only a few years ago, because they recently updated the relevant guidelines, which incorporate lessons learned over the past twenty years of digitization. Many of these are likely to be applicable and helpful in the metaverse context as well. Young markets are characterized by new entries and ample experimentation. A common exit strategy for firms is to be acquired and so the growing market will provide fertile ground for that. Meanwhile large entrants may seek to obtain a competitive advantage by snapping up smaller competitors either to eliminate the threat (killer acquisition) or to acquire their expertise in order to expand or enhance their offerings. These conditions are expected to continue until the Metaverse reaches maturity.

One last note that should be made is that competition law is not the only instrument that can be used to correct market distortions in the Metaverse. The Digital Markets Act (and also the Digital Services Act – see below), which applies to online gatekeepers and imposes relevant obligations can also apply in the Metaverse To the extent market actors in the metaverse are deemed to be gatekeepers and offer any one of the associated services (e.g. search, app stores, online marketplaces etc), the DMA can be relied on to discipline them.

5.3 Governance and Moderation

The governance and moderation of online platforms (broadly conceived) has proven a thorny issue both for governments and for regulated companies. While users may not realize it, platform terms of service essentially function as mini constitutions that define the rights and obligations of users and the platform toward each other They create a private ordering regime that applies to user activity. As the Metaverse promises to diversify and amplify user experience, the terms of service on the Metaverse become both more complicated and more consequential.

In the EU, rules for the proper governance and moderation of platforms culminated in the Digital Services Act (DSA), which was passed in 2022. It applies to intermediary services and establishes due diligence obligations tailored to certain specific categories of providers of intermediary services. The types of intermediary service providers recognised in the DSA are:

- Intermediary services: includes mere conduits, caching services, and hosting services
- Online platform: a hosting service that stores and disseminates information to the public
- Very large platforms: an online platform or online search engine which has a number of average monthly active recipients of the service in the Union equal to or higher than 45 million

The obligations that the DSA prescribes are different for each of those categories, starting with light obligations for intermediary services, and gradually more onerous for hosting services, online platforms, and very large platforms. These can range from reporting obligations, giving due account to human rights, enactment of complaint handling mechanisms, codes of conduct, to even data sharing with authorities and researchers.

The question is whether the DSA applies to the Metaverse. While there is no single version of the Metaverse, it is arguable that various services that make up the Metaverse well fall under the regulated services under the DSA Online platforms as initially conceived by the DSA included online marketplaces, app stores, collaborative economy platforms and social media platforms, but there is no reason to exclude the Metaverse from the broad definition of "online platform" in article 3 DSA: "a hosting service that, at the request of a recipient of the service, stores and disseminates information to the public".

Other instruments such as the draft AI Act can also be applicable to the Metaverse to the extent that it employs AI tools. The draft AI Act regulates AI applications if they are deemed high-risk, which are those that can usually have an impact on people's health and safety. It cannot be ruled out that such AI applications will not be part of the Metaverse, and the language used in the draft AI Act attempts to be future-proof.

It should also be noted that the Metaverse may be partly regulated by rules and norms that derive from decentralized governance (rather than rules enacted by a company). Where this is the case, the process by which governance works becomes influential. In turn, rules that place limits and requirements around governance become applicable here. The Markets in Crypto Assets Regulation (MiCA) includes governance requirements (Article 62(2)(f) and (i)) that are further specified by the European Securities and Markets Authority. These relate to entities' organizational structures, division of tasks and duties, control functions to comply with prudential requirements etc.

Lastly, while not specific to the Metaverse, actors and services on the Metaverse need to abide by the general frameworks that regulate how online services and activities are moderated and interface with users. This includes a long list of international instruments, as well as recent and ongoing attempts such as the UK's Online Safety Act 2023.

5.4 Markets in Crypto Assets Regulation (MiCA):

In recent years, crypto-assets have become synonymous with the Metaverse, intertwining digital economies with virtual environments. However, the forthcoming regulatory initiatives for crypto-assets in Europe, specifically the Markets in Crypto-Asset Regulation (MiCA), do not encompass the vast majority of integral Metaverse assets. These assets primarily feature Non-Fungible Tokens (NFTs) as their primary tool for value representation.

As of 2024, NFTs remain outside the scope of MiCA. The issuance and sale of NFTs are not considered part of the defined crypto-asset services provided by European compliant legal entities operating within the space. Instead, MiCA focuses primarily on fungible crypto-assets, which are often based on the ERC-20 token standard.

Although the NFT land parcels, which can be pivotal to Metaverse operations, are not regulated by MiCA, the issuance, trading, and exchange of fungible crypto-assets within the Metaverse must comply with MiCA requirements. This encompasses several key operations, including, but not limited to,:

- Specifications on Marketing Efforts: Ensuring that all marketing communications related to crypto-assets are clear, fair, and not misleading.
- Fund Segregation: Maintaining a clear separation between operational funds and client funds to protect investors.
- Risk Analysis and Management: Conducting thorough analyses and managing the risks associated with crypto-assets to ensure stability and security.
- Documentation for Listed Crypto-Assets: Providing comprehensive documentation for all listed crypto-assets, ensuring transparency and informed decision-making for investors.
- Regulatory Compliance: Adhering to all other regulatory requirements imposed on EU legal entities, including compliance with the General Data Protection Regulation (GDPR).

Despite these regulations, it is important to note that there is currently no direct Metaverse-specific regulation in Europe. The scope of MiCA does not entirely cover Metaverse operations, assets, and tokens. This regulatory gap highlights the need for a more tailored framework to address the unique aspects of the Metaverse.

This report aims to assist in shaping the appropriate regulatory scope for the Metaverse, advocating for a comprehensive framework that extends beyond the provisions of MiCA. Such a framework would ensure that all facets of Metaverse operations are adequately regulated, fostering a secure and transparent digital environment for all participants.

6. Risk Analysis of the Metaverse

The Metaverse is enabled by the convergence of several technologies and characterized by immersive experiences in virtual and augmented worlds by creating a strong sense of mutual presence among the participating individuals. While there are many shared environments online today, from chat rooms, social media platforms, gaming, to online marketplaces, the Metaverse introduces a wide range of new risks. In the past, companies mainly concentrated on reducing financial, legal, and organizational risks. However, due to the convergence of various technologies, “immersive experiences”, and “mutual presence” the risks to “Humans in the loop” and “Societies in the loop” must be taken into account. By foreseeing these risks, we can take proactive measures to prevent harm to individuals, safeguard communities, and preserve ecosystems.

There are multiple ways to address and mitigate the risks associated with the Metaverse. One of the ways is to think about where the risks originate from. This is where the anatomy of the Metaverse can be a helpful way to establish whether the risk originates from a technology intersection, a specific use case, infrastructure, or the characteristics such as create, connect, commerce. Identifying the source of the risk will enable us to concentrate on preventive measures using tools like safety by design and establish regulatory and government models to provide concrete guidance to specific teams.

The root of these risks is the fact that first-person immersive experiences in virtual and augmented worlds can be extremely impactful on users, having psychological impacts that rival the real world. This means users are significantly more affected by their experiences in the Metaverse as compared to other social environments. It also means that bad actors, corporate actors, state actors, and other third parties can impact users in far more personal ways in the Metaverse than traditional online platforms.

The current and future risks related to the Metaverse can be further attributed into various categories including, Human Risks, Societal Risks, Regulatory Risks, Legal Risks, Information Risks, and Financial Risks.



The actual risk could materialize into various concerns such as privacy, safety, payment integrity, compliance violation, data breach, identity issues, etc.

While the anatomy of the Metaverse provides the baseline to identify the source and establish a governance model following categories could be used to discover, analyze and mitigate these risks strategically:

6.1 Human Isolation Risks

While humans represent themselves within the Metaverse as Avatars, the risks of social isolation and cyber addiction due to their presence are very real and can have real life consequences. These risks affect the safety and well-being of humans. The Metaverse could potentially lead to individuals experiencing addiction, social isolation, cyberbullying, identity theft, or psychological harm. Individuals may also face physical harm from using devices such as VR headsets or haptic suits that could malfunction or moving around hazardous surroundings could cause injuries.

6.2 Societal Risks

The Metaverse may impose a substantial social impact, akin to how social media grew to become very influential. The metaverse will shape our future's social norms, values and communities. In worst case scenarios, the Metaverse could facilitate the spread of harmful content, including disinformation and misinformation, polarizing parts of society.

6.3 Legal & Regulatory Risks

Legal and regulatory risks can bring about significant challenges for the Metaverse as it evolves. While the regulatory risk will arise from the lack of governance, it could lead to legal uncertainty or liabilities. The legal risks could further result in disputes or lawsuits involving intellectual property, trademarks, copyright infringement, contractual disputes, etc. This is where XRSI standards and frameworks could serve as a baseline to help navigate the legal and regulatory landscape in the Metaverse.

6.4 Information Risks

These are risks that relate Confidentiality, Integrity, and Availability (CIA) of data and information generated by or exchanged within the Metaverse. It involves the collection, processing, and storage of large amounts of data which could lead to data breaches, cyber-attacks, malware infections, privacy issues due to compromise of personal information or devices.

6.5 Financial Risks

The Metaverse will involve a significant amount of financial investments. This could lead to financial risk such as monetary losses or gains associated with the Metaverse economy in the form of virtual real estate, virtual goods, virtual currencies, etc. Other forms of financial risks could include market and price volatility, taxation issues, regulatory changes, market crashes, competition, etc. Personal investments may go south, so due caution is highly recommended by INATBA to all interested stakeholders.

6.6 Psychological Well-Being Risks

As described in previous sections, interconnectivity has allowed a number of psychological risks to emerge. The Internet, and the technologies built upon the web, may lead to addictive behaviors, cyber bullying and other drawbacks that humanity has not faced before. The immersive nature of the Metaverse can exacerbate these risk as much as it can further tremendous benefits for society.

One of these controversial side effect of the internet, as described by the World Health Organization, is “Gaming Disorder”; a significant problem defined in the 11th Revision of the International Classification of Diseases (ICD-11) as a pattern of behavior with respect to “digital-gaming” or “video-gaming” characterized by increased priority given to gaming over other daily activities and interests despite the occurrence of negative consequences. Recent research suggests that virtual worlds, whether for traditional gaming or unstructured socializing can have similar addictive effects. A recent study performed by Rui Chen, Professor of the Communication University of China, found VR games evoke a 20% higher “excitement level” than traditional gaming and that VR gaming environments are 44% more addictive than flat environments.

Augmented Reality may also cause potential psychological harm and addiction. At present, the most popular use of Augmented Reality technologies are face filters on social media platforms like Snapchat and TikTok. Young people, especially teenagers, use these filters to “beautify” their appearance by reshaping, recolouring, and enhancing their faces and bodies. Such activity has caused concern, with a significant surge of “body dysmorphia” emerging in adolescents according to a study by Kaur et al (2020). The emergence of AR-enhanced Metaverse social media platforms may only exacerbate the risks that have emerged from AR use through less immersive technologies - flat, handh-held smartphone screens.

6.7 Conclusion on Risk

The Metaverse related risks listed above depend on the context which is derived from the use cases, stakeholders and the technologies involved. As we analyze the risks that seem to emerge through the rise of the Metaverse, context and deep understanding is necessary. These risks are determined by the applications, the stakeholders involved, the functionalities and the technical intersection between real life and its digital counterpart. The risk categories discussed above are not exhaustive, nor mutually exclusive, however they illustrate a significant number of the potential challenges that await us as we enter into this new digital frontier.

7. Key Findings

The Metaverse is coming. To some extent, it is already here. Risks associated with the rise of immersive virtual worlds will emerge alongside the increase in Metaverse's user adoption. New risks, that have never been accounted for, will likely emerge in the years to come, but addressing these risks should not permit and produce overregulation. Existing regulations can cover a number of Metaverse operations.

The implementation of Competition Law will ensure that early stage innovators can keep growing their Metaverse businesses, either as platforms or within platforms, without anti-competitive interference by global conglomerates. Keeping a close eye on these developments is important, especially on closed, permissioned Metaverse platforms. The same is true for M&A activities, which are sure to increase in frequency in the years to come.

However, the market needs clearer and more direct guidelines on their Metaverse activities now. How are these existing laws applied onto them? What are the areas of regulatory lack of clarity, and how are Standard Organizations seeking to address these gaps? Perhaps the introduction of a Regulatory Sandbox can ensure segmented compliance alongside global competitiveness for all jurisdictions that seek to lead this emerging industry. Such a light-touch approach will provide clarity, the rails for long term, sustainable growth and consumer protection.

Areas that do need additional regulatory clarity remain a hurdle in the Metaverse's progress. Hardware, as in VR headsets and AR technologies, will become increasingly intertwined with daily consumer habits. These hardware products come with a myriad of new potential risks that are only exacerbated by the immersive nature of the future Metaverse. How will these risks be mitigated? How will data, especially biometrical data, be produced? How will these technologies become resilient to hacking and other potential limitations that will only increase in their frequency? All the above questions seek answers, both from the industry and from policymakers. This becomes increasingly important for Metaverse application in medicine and private business - where privacy is absolutely necessary.

Finally, outside of the demonstrated benefits to these technologies, psychological health has been negatively impacted by the rise of existing social media. An immersive world that runs 24/7 will only add to these negative externalities. Addressing such risks through thorough education is extremely important for the long term benefit of humanity as a whole. Education initiatives are highly recommended. Internet health and psychological self management as educational pathways might be the proper way forward, and INATBA recommends an in-depth review on how these topics can be added to schooling curricula.

Ultimately, the above key findings are tied to industry activity and incentives. The Metaverse has the potential to change business models for many of the world's leading internet companies. This can make online experience significantly more immersive and beneficial. Simultaneously, this transition increases uncertainty of how the future of society will look.

The Metaverse would not be possible without industry. These companies are the driving force behind technological and Metaverse advancements. Finding a way to reword the industry for setting up the rails for interoperability and the decrease of consumer risk is very important. Finding the proper incentives to align everyone affected by the Metaverse is the only way that this technology can be shaped to work for the benefit of us all.

8. Summary

The Metaverse is the future of the Internet, an evolution that was predicted decades ago but which is at the cusp of realization today. As with many future technologies, the way the Metaverse will be realized can diverge into many directions, some closer to the values that INATBA aspires to achieve, and others further from these principles; all potential futures, however, will have a tremendous impact on the way humanity and society operate.

Differentiating between what can be, what will be and what exists today is one of the most fundamental targets of this report. The Metaverse, some would say, exists already. Its proto-steps being the content and connections one has on their phone, or gaming console, and perhaps even the way that one interacts with this report. But the future of the Metaverse will be much more dynamic. INATBA understands that the dichotomy of closed-permissioned vs open-permissionless is a false one. In fact, the future of the Metaverse is both, and perhaps even more.

Some applications will benefit from limited access, such as medical and business collaboration processes, while others must remain open and permissionless. When it comes to social platforms, this report indicates how Blockchain technology can introduce robustness, monetization and self-sovereignty, allowing the participants of these networks to benefit from the value that they themselves create for these platforms. But this future also comes with risks - risks that society is not ready to address.

Psychological risks, data protection risks and financial risks are all tied to the Metaverse. Unknown risks are also certain to emerge. Existing regulations can help ensure that the future of the Metaverse does not spiral out of control, but regulatory gaps do exist. Non-regulatory actions must also be reviewed, like proactive education that ensures a psychological shield for Metaverse users that are the most vulnerable to the negative side effects of a virtual, constant digital companion to the world.

INATBA's report is a review of how the Metaverse will develop in the years to come, as well as an expedition into how this technology can be shaped to assist society moving forward. A regulatory sandbox, and close industry supervision, seems like the most effective way forward.

Ultimately, the future of society will be shaped by the Metaverse, in whatever form this Metaverse comes. This is an exciting time to be alive; experiencing a fundamental shift of how humanity interacts with the emerging virtual world. An effective handling of the development of these new and virtual worlds is for the benefit of all future generations.

INATBA welcomes the Metaverse, and invites all interested stakeholders to join our future work streams on this subject. INATBA also welcomes feedback on the report, and any potential bi-lterals with policy makers that will ensure the open, permissionless future of the Metaverse. For all interested parties, please contact info@inatba.org with your questions, feedback and requests for clarification.

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