

Genesis and evolution of metaverses as socio-technological realities

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Article Info	Abstract
<p>Review Article</p> <p>Main Object: Culture Scope: Interdisciplinary</p> <p>Received: 08 February 2026 Revised: 06 April 2026 Accepted: 12 April 2026 Published online: 17 May 2026</p> <p>Keywords: conflict potential, metaverses, platforms of virtual reality, social/community interaction, social interaction, socio-technical space.</p>	<p>This article focuses on exploring the evolution of metaverses as socio-technological virtual spaces, which, with further development, will lead to the growth of existing or potentially new forms of social interaction. Approaches to defining the key characteristics and stages of metaverse development are considered. Various forms of social activity within metaverses are analyzed with reference to specific examples, such as political activity, economic activity, and the implementation of socio-cultural projects. The article is based on a systemic analysis that enables the consideration of the technological and social aspects of metaverse development in their interrelation and dynamics, as well as scenario analysis to predict future forms of social interaction in virtual spaces. The emergence of increasingly new forms of social interaction may lead to the manifestation of a confrontational political potential, expressed in virtual protests, rallies, calls for a change of power, etc. The derived conclusions highlight the importance of developing inclusive mechanisms and models for managing and regulating metaverses in terms of social, public, and political risks.</p>

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1. Introduction

Today, humanity is approaching the creation of metaverses, fundamentally new socio-technological realities that will permeate all levels of social and human existence, leading to revolutionary changes in the economy, socio-political relations, the entertainment industry, and more.

The metaverse, as a disruptive technology, places humanity on the threshold of a new stage in its evolution and marks the beginning of a “Reality 2.0” era, a “hybrid” existence in which human “physical” life will be inextricably linked to the virtual. The metaverse will enable the intrusion of the virtual world into the physical domain and alter the very perception of both physical and virtual realities.

This article seeks to examine the evolution of metaverses as socio-technological spaces and, from this perspective, to show how their technological and conceptual development progressively reproduces and enables an increasing number of existing or potentially new forms of socio-public interaction in virtual reality. The authors also attempt to forecast the promising forms of social and community interaction in the metaverses of the future.

At the same time, the future development of metaverses as socio-technological realities, as well as the emergence of new forms of social interaction and the increasing complexity of virtual society, will raise significant ethical issues that affect the very foundations of social development, such as identity, inter-user communication, psychological security, equality, and discrimination.

The metaverses can play an important role in the development of BRICS (which includes Russia and Iran) as a promising space for international development, strengthening social and interethnic ties within the framework of the association, and a tool for advancing the BRICS agenda, including through strategic communication.

The relevance of this article is underscored by the current development of metaverses, the growing volume of investment in their infrastructure, and the increasing number of users. Previous studies have not systematically addressed the genesis and evolution of metaverses from the standpoint of the reproduction and development of new forms of social interaction, conflict potential, and social activity within them. This article aims to fill that gap and contribute to a broader discussion of this set of issues.

The aim of the study is to comprehensively explore the evolution of metaverses as interconnected socio-technological spaces, consider the potential for unleashing various forms of social activity within them, and identify the relationship between the development of metaverses and the transformation of social interactions.

The importance of this research is accounted for by the current technological transformation and radical change in traditional ways of living, where physical processes are inextricably linked to digital ones.

At the same time, there remains a significant gap in the academic discourse between the practical implementation of technologies and the interdisciplinary interpretation of social consequences thereof. The work demonstrates how modern forms of virtual activity have shifted from purely “gaming” to acts of expressing a social potential. Thus, the importance of this work is dictated by the need for a theoretical conceptualization of metaverses as complex socio-technological spaces capable of transforming social activity.

The scientific novelty of the work lies in its systematization and holistic vision of the genesis of virtual reality platforms, which are considered social interaction technologies. Moreover, the analysis of contemporary cases has shown a transformation of confrontational potential, which allows for a deepening of the methodology for studying political processes in the future. An important contribution of this work is the development of a definition of the metaverse, which focuses not on the technology itself, but on the potential for social interaction.

The article is based on a systemic analysis that enables the consideration of the technological and social aspects of metaverse development in their interrelation and dynamics, as well as a scenario analysis to forecast future forms of social interaction in virtual spaces.

The work is also based on an analysis of retrospective and contemporary cases of virtual reality platform development. In development of virtual reality platforms, some elements of the socio-technical approach have been used. It should be noted that the novelty of the area under study and its complexity as a socio-technological system objectively hinder a complete and comprehensive understanding of its future development dynamics. In this regard, the somewhat interpretative nature of the obtained results should be considered in terms of the specific analysis of the so far emerging metaverses.

To reduce the level of interpretative bias, the authors have resorted to a synergy of system analysis, case studies and empirical data, which enabled them to somewhat constrain the subjectivity of deduced interpretations and improve the analytical component.

The research draws on a wide range of primary and secondary open sources. Most primary sources include reports from international organizations, statistical materials, and news press releases. The secondary sources consist mainly of academic literature related to the subject of the paper.

When selecting real cases, the authors were guided by the following criteria: 1. The presence of certain social activity forms on virtual reality platforms along with the scale and level of their institutionalization; 2. The availability of open data on the research subject.

Although the work is primarily of a theoretical and analytical nature with elements of scenario forecasting, it makes use of observable and

relevant empirical data. These include: 1. The coverage of the user audience; 2. The scope of the metaverse market; 3. The number of active users per month, etc. These data made it possible to correlate analytical conclusions with the actual practices of the metaverse functionality as a socio-technological reality.

2. Discussion

2.1. Metaverses: Approaches to defining digital reality

The concept of the metaverse is still in its formative stage. One can observe a gradual accumulation of ideas concerning its nature, characteristics, and functionality. This is evident in the growing number of academic publications, analytical reports, expert opinions, and other materials that offer diverse interpretations of what a metaverse is. However, these ideas remain fragmented and lack a systemic foundation. At present, the key actors who are likely to shape the direction of metaverse development, users, development companies, expert futurologists, policymakers, academic communities, etc., do not share a harmonized understanding of the essence of metaverses or their future prospects (Marler et al., 2023: 4; Dolata & Schwabe, 2023: 240). Interpretations and definitions of the metaverse vary significantly depending on the goals and interests of specific actors (Marler et al., 2023: 4; Dolata & Schwabe, 2023: 240; Jauhainen, 2024: 262; Park & Kim, 2022). This diversity complicates efforts to formulate a unified academic definition of the metaverse and to forecast its future development (Marler et al., 2023).

At the same time, it is important to consider the existing approaches to defining the metaverse, its characteristics, and functionality in order to understand current development trends and assess its potential as a tool for social activity (Kaur et al., 2024: 2).

Several authors (Park & Kim, 2022; Ritterbusch & Teichmann, 2023; Hajian et al., 2024) have provided comprehensive reviews of the scholarly literature and existing definitions of the metaverse. Sang-Ming Park and Young-Gab Kim, after analyzing 54 definitions proposed between 2000 and 2022, define the metaverse as a three-dimensional virtual space in which political, economic, social, and cultural activities can be realized, while also emphasizing its physical dimension (Park & Kim, 2022: 4211). Georg-David Ritterbusch and Malte Rolf Teichmann systematize definitions drawn from academic literature, categorizing them by scientific discipline (Ritterbusch & Teichmann, 2023). Ava Hajian and co-authors conducted a systematic review of over 1,300 articles, illustrating the metaverse's impact across various spheres of society (Hajian et al., 2024).

One of the most comprehensive definitions is arguably provided by Stylianos Mystakidis in his essay "*Metaverse*", where he describes the metaverse as a "permanent, consistent, and interconnected web of socially networked immersive environments combining physical reality

with digital virtuality.” This definition emphasizes the convergence of technologies enabling multi-sensory, dynamic interaction with virtual environments, such as virtual reality, augmented reality, digital objects, and people (Mystakidis, 2022: 486).

Many approaches to defining the metaverse, as outlined in academic papers, analytical reports, and other sources, conceptualize it as a new incarnation of the global Internet and a natural next stage in its evolution – an immersive¹ 3-D Internet offering the possibility of full immersion and interaction with other entities, institutions, processes, and events, as well as with digital objects and data (e.g. text, audio, video files, etc.) (Choi & Kim, 2017; Buana, 2023: 28-29; Terry & Keeny, 2022; *Europol*, 2022: 5, 7; *World Economic Forum*, 2023: 3; Kaur et al., 2024: 1; *Interpol*, 2024: 4-5). It is important to note that, according to surveys, 90% of respondents consider the metaverse to be the next incarnation of the internet (KPMG, 2023).

Currently, new conceptual frameworks are being developed that expand the understanding of the metaverse to that of an operational space representing a hybrid reality, a “seamless” convergence of virtual and physical spaces marked by deep interpenetration. This convergence enables a parallel, cross-domain extrapolation of immersive experiences from the physical world to the digital one and vice versa: users engage in immersive experiences in one world, while the results are simultaneously reflected in the other (Choi & Kim, 2017; Falchuk et al., 2018; Kim, 2021; Mystakidis, 2022: 486; *Europol*, 2022: 7; Cho et al., 2023: 12; *World Economic Forum*, 2023: 5; Buana, 2023: 29; Askr et al., 2023).

Based on systemic analysis and the wide range of metaverse definitions, several core elements common to most conceptualizations can be identified:

First, the metaverse is fundamentally digital, artificially constructed, and virtual in nature.

Second, it consists of a network of interconnected virtual worlds, rather than a single global space (Kim, 2021; Mystakidis, 2022: 486, 492; Floridi, 2022: 2; Buana, 2023: 29; Cheng et al., 2023).

Third, comprehensive metaverses represent a convergence of physical and virtual realities (Choi & Kim, 2017; Falchuk et al., 2018; Mystakidis, 2022: 486; Cho et al., 2023: 12; Buana, 2023: 29; Askr et al., 2023).

Finally, a key characteristic of metaverses is the possibility of active immersive interaction between actors in virtual processes, typically through digital representations such as avatars or userpics (Gadalla et al., 2013; Mystakidis, 2022: 486-488; Cho et al., 2023; Ritterbusch & Teichmann, 2023: 12373; Coeckelbergh, 2024: 1, 3, 7; Kaur et al.,

1. Immersiveness – being immersed in a virtual world, with the possibility of getting a comprehensive experience of presence.

2024: 1, 11; Soliman et al., 2023: 249-250). For example, Matteo Zallio and P. John Clarkson (Zallio & Clarkson, 2022), as well as Hyun Jung Oh et al. (Oh et al., 2023), view metaverses as representing a new technological stage in the evolution of social interaction.

Beyond these foundational elements, various definitions of the metaverse are shaped and supplemented by specific approaches, goals, and interests of the actors employing the concept.

Many definitions are framed in terms of economic resources and business opportunities. For instance, Justin Cho, Mandy Claudia tom Dieck, and Timothy Jung, in one of their studies, define the metaverse as an “augmented” digital world that blends physical and virtual spaces through extended reality technologies and artificial intelligence systems. Their definition emphasizes the ability for users to interact and trade virtual goods and services, often using cryptocurrencies such as NFTs, with other virtual actors (Cho et al., 2023: 19).

Mark Coeckelbergh, a philosopher of technology, adds a political and social dimension, asserting that metaverses will become an integral part of political and social reality. He also conceptualizes them as “real” spaces closely linked to the dynamics of the physical world (Coeckelbergh, 2024: 2, 7, 8).

Jussi S. Jauhiainen focuses on the innovation potential of metaverses, viewing them as platforms for fostering scientific and technological discoveries, innovation development, and effective research through the use of AI technologies (Jauhiainen, 2024).

Another actively developing concept is that of “industrial metaverses”, which are viewed as virtual platforms for creating “*digital twins*”, digital replicas of industrial facilities, equipment, and production processes. These are intended to optimize operations, support the design of new products, improve and monitor production efficiency, and ensure minimal physical intervention in production processes (Jones et al., 2020; Aloqaily et al., 2022; de Giovanni, 2023; Jauhiainen, 2024: 262, 264, 267; Cheng et al., 2023).

The views of private companies on metaverses can also be considered as a distinct category within the broader spectrum of conceptual approaches (Marler et al., 2023: 4; McStay, 2023: 5-8; Dolata & Schwabe, 2023: 253). In these approaches, metaverses are presented as spaces for corporate communication with customers and other firms to solve business-related tasks, facilitate recreation, entertainment, work, and more. Companies see metaverses as digital environments offering attractive, immersive consumer experiences and new interactive virtual services (Kaur et al., 2024: 3). For instance, Microsoft, in launching its Mesh for Microsoft Teams, highlights opportunities for virtual corporate interaction aimed at achieving business objectives (Roach, 2021). Similarly, Meta defines the metaverse as a collection of digital spaces for communication, gaming, shopping, working, learning, etc., and as a natural stage in the evolution

of social interaction, primarily through easily commercialized domains (*Meta*, 2024).

Despite the variety of existing approaches to defining the metaverse, its characteristics, and functionality, a fundamental point of agreement among the involved actors is that metaverses represent a disruptive technology. This technology is expected to bring about profound changes in human and societal existence, impacting economic, political, and social processes, transforming interpersonal and societal interactions, contributing to the emergence of a full-fledged “metaverse economy,” and altering human psychology in terms of how virtual and physical realities are perceived (Dwivedi et al., 2022; Buana, 2023; Dolata & Schwabe, 2023; Kaur et al., 2024; Hajian et al., 2024; Coeckelbergh, 2024: 4).

Researchers are increasingly exploring the potential applications of metaverses in non-entertainment fields such as science, education, commerce, socio-cultural activities, and environmental protection (Cho et al., 2023: 4). Wisnu Buana, for example, predicts major transformations in social interaction and public life resulting from the expansion of metaverses and the rising number of users, thus introducing a sociological dimension to the analysis of metaverses (Buana, 2023). Mateusz Dolata and Gerhard Schwabe argue that metaverses are subject to political and economic diffusion and should not be seen as fixed technological phenomena (Dolata & Schwabe, 2023: 240). It is also essential to note that the visions of the future, particularly those involving the metaverse, are influenced by the interests of the entities making assessments or commissioning forecasts (Bondarenko, 2017: 238). As such, projections about the metaverse often reflect a complex and sometimes contradictory mix of cutting-edge technologies, immense financial investments, and both unprecedented opportunities and significant risks.

Given the complexity of the phenomenon, no unified or universally accepted conceptual definition of the metaverse currently exists, and for objective reasons (Kim, 2021; Marler et al., 2023; Mystakidis, 2022; Dolata & Schwabe, 2023; Oh et al., 2023; Kayakoku, 2023; Jauhiainen, 2024: 264; Askr et al., 2023; Cho et al., 2023). Several researchers conclude that, at this stage, the emergence of a universal and comprehensive definition is unlikely (Xu et al., 2022).

Based on the objectives of this research, however, it seems appropriate to describe the metaverse as a global, full-fledged virtual space continuously functioning in real time (or a growing set of interconnected virtual spaces), providing users (including individual actors, companies, and public institutions) with a unique experience of immersive interaction. This interaction occurs with other users, digital assets, virtual worlds, events, and processes through extended reality (XR) technologies and “digital interfaces” (e.g. avatars, digital offices, and virtual representations). It encompasses various spheres of social

life and enables diverse forms of social, political, economic, cultural, professional, and personal interaction.

This working definition aligns with the goals of the present study and offers a foundation for analyzing the socio-humanitarian prospects of metaverse development as a socio-technological phenomenon. At the same time, it is important to recognize that the concept of the metaverse continues to evolve alongside the increasing complexity of society and the emergence of new areas in which its potential can be realized.

The analysis of existing approaches to defining metaverses revealed that most interpretations focus on consider the economic, marketing, or gaming potential of metaverses (Kaur et al., 2024; Cho et al., 2023: 19; Dolata & Schwabe, 2023; McStay, 2023), while excluding their social transformation and the study of virtual social interactions. This work fills this gap by presenting metaverses as an evolving socio-technological reality.

2.2. Genesis and evolution of metaverses: Development of virtual realities with manifested forms of social activity

Attempts to create functional virtual worlds with inter-user communication capabilities have been made over the past several decades. From technological, infrastructural, and conceptual perspectives, the development of “proto-metaverses”, the earliest virtual spaces enabling interpersonal interaction, began in the 1970s with the emergence of “multi-user dungeons” (MUDs). In these environments, interaction with other users or the virtual world, as well as all user activity, was carried out through text-based commands, with immersion in the game space occurring primarily via text displayed on the screen (e.g. descriptions of spaces, objects, and game plots) (Kayakoku, 2023: 20-21; *Europol*, 2022: 9). A key feature of MUDs was that users operated within confined environments governed by predefined settings and rules, which rendered them relatively passive participants in the virtual space.

The next generation of virtual platforms following MUDs was known as multi-user shared hallucinations or multi-user experiences. Their main distinction lay in offering users greater autonomy: players could now set their own goals, modify game plots, and create custom gameplay scenarios.

A major milestone in this progression was the release of the multiplayer online virtual game *Habitat* in 1986 by Lucasfilm. *Habitat* significantly expanded the possibilities for inter-user communication, allowing for the emergence of primary or rudimentary forms of social interaction and collective activity. In contrast to MUDs and MUXs, *Habitat* offered improved graphical interfaces and enhanced functionality, while also granting users greater freedom of action within the virtual space. This shift allowed players to become active participants rather than passive users, and even enabled the formation

of early virtual communities. Within *Habitat*, users could establish laws, regulate each other's behavior, and engage in various forms of social organization and public interaction.

Furthermore, *Habitat* became a space where conflict potential could manifest. Users were able to loot or even virtually kill one another, leading to instability within the game world. This, in turn, prompted the self-regulating gaming community to implement new norms of behavior.

The development of “proto-metaverses” in the 1990s was characterized from a technical and functional perspective by the following key features:

1. advances in computing capacity;
2. development of 3D graphics, the emergence of isometric three-dimensional 2.5D spaces and virtual 3D worlds;
3. expanded interactivity of virtual platforms;
4. development of communication facilities.

The key advancement during this period was the realization of platforms that enabled users not only to interact within virtual environments but also to create and populate those spaces with content. Users became active participants with the ability to modify and shape virtual worlds. This functionality emerged in platforms such as *Web World* (1994) and *Activeworlds* (1995).

At this stage, the developmental, functional, and technological complexity of proto-metaverses already reflected forms of human interaction and behavior that were quite broad for the time.

The 2000s saw the emergence of virtual worlds that laid the foundation for key characteristics of today's metaverses. The platforms developed during this period significantly advanced the potential for virtual interpersonal and social interaction, both in terms of the variety of interaction forms and the number of participants.

The launch of *Second Life* in 2003 marked a turning point. As the first full-fledged virtual world featuring three-dimensional graphics and interactive features, *Second Life* introduced a conceptual “shift” by opening a discussion around the possibility of parallel virtual existence and new modes of virtual interaction.

First, *Second Life* enabled new forms of communication and interaction between individuals, institutions, agencies, and private organizations. It facilitated not only interpersonal and intergroup virtual communication, but also allowed for interactive engagement between corporate structures, associations, and users. Companies such as Coca-Cola, Adidas, BBC, and IBM explored how this environment could support customer engagement. Embassies from countries including the Maldives, Sweden, Estonia, Colombia, Serbia, and Malta opened virtual offices in *Second Life* (see, for example: Republic of Estonia, Ministry of Foreign Affairs, 2007). Religious organizations of various

faiths also established virtual “churches” to hold services and meetings (Schlosser, 2013).

Second, *Second Life* sparked debate over political activism and the expression of protest potential within virtual environments. In 2007, for instance, the virtual headquarters of U.S. Democratic presidential candidate John Edwards was vandalized with obscene messages and ultra-leftist slogans (Council of the European Union, 2022: 10).

Third, *Second Life* demonstrated the possibilities of virtual economic interaction and laid the groundwork for an internal digital economy. It created an ecosystem where users could earn money using the in-game currency, LindenDollar, which could be exchanged for real-world currency (Kayakoku, 2023: 23). In 2007, the platform introduced an in-game stock exchange, allowing companies present in *Second Life* to raise capital in LindenDollar (ibid). Users could also trade digital goods, services, and virtual real estate.

The next stage in metaverse development is associated with the rise of *Roblox* (2006) and *Minecraft* (2011). These platforms advanced global communication and public engagement through increased interactivity and more accessible user interfaces. A key feature was the ability for users to create, modify, and populate virtual worlds with user-generated content.

Roblox was one of the first platforms to allow users not only to play games but to create multiplayer games themselves. It enabled users to develop and test game-related ideas, while the platform provided the tools necessary to expand and scale them. *Roblox* unlocked diverse forms of user communication and supported a wide range of behavior models within games.

Technological improvements in virtual platforms also enabled *Minecraft* to support large-scale virtual construction. Users created massive structures, entire worlds, and even real-world replicas. *Minecraft* demonstrated how the act of construction itself could enable deeper immersion and social interaction. One notable example occurred in February 2020, when a Chinese player community recreated the Huoshenshan and Leishenshan medical centers, originally built in Wuhan during the COVID-19 outbreak, as a tribute to healthcare workers (Ye, 2020).

Minecraft-style virtual platforms, initially created as gaming and creative spaces, represent another stage in which users began to shift away from purely gaming experiences toward the expression of more complex forms of social interaction, including those of a protest nature.

In 2017, the open-world platform *Fortnite* was launched. In 2018, it introduced *Fortnite Creative Mode*, allowing users to generate their own objects. Today, *Fortnite* is gradually transforming from a purely gaming platform into a social one, enabling non-gaming experiences. For instance, in June 2024, the platform hosted a virtual concert by *Metallica* (Webster, 2024). The event was rich in interactivity and

special effects and attempted to combine the experience of a live concert with gameplay elements.

A significant milestone in the history of metaverse development was the emergence of affordable virtual reality headsets in the 2010s, which enhanced both interactivity and immersive potential. Various IT companies entered the race to develop VR headsets in order to gain a competitive edge in the metaverse sector. Virtual reality has become increasingly accessible, with a growing number of headsets available in both consumer and commercial categories (Mystakidis, 2022).

Through these developments, companies aim to secure leading positions in the future digital economy by attracting users into their own metaverse ecosystems. In the face of intense competition, they are compelled to design devices that offer increasingly immersive experiences and to expand forms of virtual social interaction. This involves building comprehensive ecosystems comprising proprietary, centralized metaverses and compatible XR devices.

The conceptual and technological development of metaverses was significantly accelerated by the COVID-19 pandemic, during which people, faced with isolation, began to seek alternative immersive methods of social interaction to simulate face-to-face communication (Ball et al., 2021; Park et al., 2021: 4238; Zallio & Clarkson, 2022: 2; Oh et al., 2023: 1-2; Buana, 2023: 28-29; Cho et al., 2023: 4; Kaur et al., 2024: 6). This period marked a surge in virtual social activity: people held company meetings and conferences in *Minecraft*, attended virtual concerts, and organized graduation parties in digital environments. Statistically, global spending on VR headsets, related software, and services in 2020 increased by 50% compared to 2019, reaching \$12 billion (Vardomatski, 2021).

Today's virtual platforms, *Decentraland*, *Horizon Worlds*, *Roblox*, *The Sandbox*, *Fortnite*, and *Minecraft*, offer a broad spectrum of opportunities for social and community interaction. In 2019, Facebook introduced the *Facebook Horizon VR* social network, designed to deliver the most advanced virtual reality user experiences. Now known as *Horizon Worlds*, the platform includes numerous user-created environments. One of its key features is a 3D object editor that allows for rapid expansion of virtual spaces. The company's overarching aim is to blur the boundaries between physical and virtual worlds through the integration of virtual and augmented reality technologies. In October 2021, Mark Zuckerberg announced that Facebook Inc., the parent company of Facebook, Instagram, WhatsApp, and Reality Labs, would be renamed *Meta Platforms Inc.* to reflect its strategic shift toward building the "metaverse".

In 2020, *Decentraland* was launched, currently one of the most populated metaverses, which supports a wide range of social relations. The platform hosts concerts, conferences, parties, socio-cultural projects, group meditation, and psychotherapy sessions. Notably,

Decentraland is governed by a Decentralized Autonomous Organisation (DAO), meaning the platform adheres to democratic principles where governance issues are resolved by user consensus through blockchain technologies.

The COVID and post-COVID periods, despite their differences, are characterized by a higher technological level in metaverse development and by an ever-growing diversity in forms of human interaction within virtual environments.

2.3. Metaverses: Present and Prospective forms of social interaction

The preceding historical experience and the evolution of virtual realities clearly demonstrate that their growing technological and conceptual sophistication leads to a corresponding complexity in the social processes that occur within these digital environments. As a result, an increasing number of social interaction forms emerge, many of which can have tangible effects in the real world. According to forecasts, by the 2030s the metaverse will be capable of reproducing the full spectrum of processes and interactions found in the physical world (Kaur et al., 2024: 9). It can also be anticipated that, with the continued emergence and development of full-fledged metaverses, an even broader range of social interaction forms will arise across various spheres of human activity.

For further analysis and understanding of how social interactions in metaverses may be realized and reproduced in the future, it is necessary to establish an empirical basis that would demonstrate the potential of immersive spaces as socio-technological realities.

The emergence of new virtual forms of social interaction is particularly relevant in light of the growing number of users drawn to the immersive experiences offered by metaverses. In 2024, the number of active metaverse users exceeded 600 million worldwide (Hryziuk, 2024), and by 2030, this figure is projected to reach 2.6 billion (Statista, 2024).

As of 2025, the monthly number of active users of virtual reality platforms was estimated at approximately 700 million people (Duarte, 2025), and by 2030, this figure is projected to reach 2.6 billion (Statista, 2025).

At present, virtual platforms are realizing their main potential in the following sectors: 1. the online gaming and entertainment industry, with the market estimated at \$31.6 billion in 2025; 2. the e-commerce sector (TwinStrata, 2025).

The projected size of the metaverse market in 2026 is \$150 billion. According to various estimates, by 2030, the scope of the metaverse market can reach a figure ranging from \$507.8 billion (Statista, 2025) to \$1.1 trillion (Research and Markets, 2026).

The demonstrated empirical indicators of modern virtual reality platforms indicate their significant development and scaling, as well as

continually expanding functionality and control mechanisms. Today, the largest virtual reality platforms already count hundreds of millions of registered users. For example, the Roblox platform has 214 million monthly users, Fortnite – 236 million, and Minecraft – 166 million (*TwinStrata*, 2025).

At the same time, non-gaming activity forms are growing and developing, including socio-cultural events, conferences, and even political processes. The following models of metaverse management can be distinguished:

- Centralized platforms, that are created and managed by a specific entity (corporation), are commercially oriented, and the metaverse's development policy, functionality, and interaction capabilities are determined by the company's corporate policy.
- Decentralized platforms, that are managed collectively by independent entities which equally participate in their development.

These different approaches to creating and managing metaverses also show how a particular socio-technological architecture influences the nature of social activity, communication, and social interaction among users.

2.3.1 Current forms of social interaction in metaverses

According to analytical studies, metaverses represent a tool for diversifying the development of existing social processes (*World Economic Forum*, 2023).

Combating crime is currently a prime example of how public interaction and corporate intercommunication are being enhanced through metaverse technologies. In October 2022, during Interpol's 90th General Assembly, the organization announced the launch of the world's first "police" metaverse, designed specifically for law enforcement agencies. This platform allows officers to interact through avatars and take immersive forensic investigation training courses (*Interpol*, 2022).

Another area benefiting from the development of metaverses as promising platforms is the socio-cultural domain, which has the unique capacity to project experiences from virtual spaces into the real world. Art projects, cultural activities, and entertainment events are already being integrated into metaverse environments. In 2021, Sotheby's auction house opened a virtual art gallery in *Decentraland*, a replica of its London headquarters, where users can explore, create, and sell digital artworks (Studebaker, 2023). It can be assumed that, with the introduction of new technologies and expanded functionality, metaverses will offer even broader opportunities for immersive public interaction within the socio-cultural sphere. These may include collaborative creation of artworks and virtual projects, large-scale

digital creative activities, virtual master classes, and public discussions.

Another area currently benefiting from the metaverse's growing potential for public interaction is politics, encompassing activities such as interactive campaigning, virtual protests, debates, and influencing electoral behavior. In October 2023, over 348,000 people participated in *Dataran Tanjung Mas*, a virtual demonstration for the liberation of Palestine, held on the *Roblox* platform (*Arab News*, 2023). It was reported that the virtual format enabled broader participation by supporters of the Palestinian cause. However, the *Roblox* platform applied censorship mechanisms during the event, banning the use of terms such as "Free Palestine" and "Genocide" (*ibid*). This example illustrates that while virtual reality can serve as a powerful space for protest and activism, it is also subject to political control and moderation by platform owners.

As technological and conceptual development continues, metaverses are likely to unlock even broader forms of political activism.

Today, metaverse evolution has reached a stage where an increasing number of institutions, companies, agencies, and organizations aim not only to establish a presence in existing metaverses, through representative offices or personalized virtual spaces, but also to create their own metaverses. These metaverses are tailored to reflect the identity of the organization that created them and are equipped with the specific functionalities needed to support social interaction, aligned with the entity's goals, strategy, and commercial objectives. On 16 January 2023, the Seoul Metropolitan Government launched *Metaverse Seoul*, a digital metaverse replicating the city, where users can interact with one another and access government services (*World Economic Forum*, 2024). *Metaverse Seoul* is a vivid example of the growing "socialization" of metaverses, demonstrating that virtual spaces are no longer used solely for entertainment, but increasingly for addressing real-world social challenges.

At the same time, it is crucial to recognize that the rise of new forms of social and public activity in metaverses also leads to the emergence of conflict potential and virtual threats. The early examples of full-fledged virtual realities, *Horizon Worlds*, *Decentraland*, *Roblox*, *Second Life*, already exhibit a wide range of such issues, including financial fraud, data theft, psychological manipulation, protest mobilization through destructive means, and sexual harassment.

The analysis demonstrates that social interactions manifested within modern virtual reality platforms are systemic and, at the same time, evolving in nature. The study identifies and records systemic practices for the realization of various mass events: socio-cultural events, political campaigns, as well as the functioning of institutional virtual representations.

The following conclusion can be drawn: the scope of user participation and involvement in virtual processes and activity forms

suggests that metaverses represent functioning social interaction spaces rather than purely experimental digital environments.

2.3.2 Prospects for the development of social interaction in metaverses

Comprehensive metaverses are expected to significantly enhance the efficiency of education (Onu et al., 2023). They will introduce fundamentally new interactive learning formats, such as time and space travel, and the simulation of complex or dangerous experiments. These environments will promote better socialization, allow for simultaneous immersive experiences with other participants, and offer opportunities to learn from leading experts and lecturers.

A fully functioning economy is projected to be one of the most important spheres of interaction within metaverses, potentially reaching unprecedented scales. Individuals will be able to engage in a wide range of financial activities, creating, selling, and purchasing goods and services, generating profits, making investments, and owning property. Metaverses will offer comprehensive opportunities for economic development and financial growth. Already today, users invest real money, purchase virtual property, and companies establish virtual offices to expand their presence and scale operations.

However, the same immersive capabilities that enhance metaverse experiences can also be exploited by malicious actors. Metaverses may be used for terrorist activities, the formation of destructive movements and meta cults (Sebekin & Kalegin, 2023: 592, 601; Pashentsev & Sebekin, 2023: 49-50). There is a growing concern that terrorist organizations could use metaverses to recruit new supporters, disseminate extremist ideas, and coordinate the actions of global cells. They might also organize harmful events accessible through NFTs¹, while leveraging blockchain technology and crypto wallets to maintain anonymity (Sebekin & Kalegin, 2023: 601). Metaverses are expected to introduce a new spectrum of high-tech threats, increase both the quantity and sophistication of digital crime, and give rise to entirely new types of offences and conflict potential. Nevertheless, hindering metaverse development would mean forfeiting the many advantages offered by technological progress.

It is essential to consider the key enabling technologies that will drive the creation of metaverse architecture. Metaverses are the product of scientific and technological progress, and the natural outcome of the convergence of numerous innovations. These include augmented and extended reality technologies, artificial intelligence (AI), blockchain, NFTs, 5G and 6G networks, and cloud computing, among others. These technologies already underpin metaverse functionality and define their developmental trajectory and the range of possible social activities

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within them (Mystakidis, 2022: 486; Terry & Keeny, 2022: 57; Cho et al., 2023; *Interpol*, 2024: 5).

Virtual reality immersion tools, AI systems, and 6G networks will provide significant prospects for advancing social processes. The continued development of virtual reality (VR) and augmented reality (AR) technologies will stimulate the emergence of new communication forms. While VR presents a fully simulated environment, AR overlays virtual elements onto the physical world. Together, these technologies constitute extended reality (XR) (Vasarainen et al., 2021; *Europol*, 2022: 7; Buana, 2023: 28; Hajian et al., 2024). XR will allow users to fully immerse themselves in digital spaces and enable unique experiences of presence and interaction with both other users and digital objects. Crucially, XR will also enable the convergence of physical and virtual worlds, allowing for the integration of real-world objects into metaverses and vice versa. In the future, XR may be facilitated through advanced interfaces such as neural implants or indwelling digital devices.

The integration of AI technologies will unlock vast potential for social interaction in metaverses. Users will engage with “digital humans”, non-player characters functioning as 3D analogues of chatbots, for communication with companies, government agencies, and institutions.

AI will also support the recognition and processing of natural language and text, transformation, and instant translation (Sebekin & Kalegin, 2023: 589, 591; Pashentsev & Sebekin, 2023; Huynh-The et al., 2022: 5), thus facilitating truly global communication and eliminating language barriers in virtual environments.

AI will become a central element in the architecture of metaverses, ensuring the structural coherence of complex systems and supporting interaction between their diverse components. This will, in turn, enable new forms of social interaction. Similarly, the emergence of next-generation communication networks (e.g., 6G) will not only accelerate information exchange but also shape new forms of engagement, by enabling real-time responses, simultaneous shared experiences, increased user volumes, and greater process complexity that demands high-speed connectivity (Tang et al., 2023; Jauhainen, 2024: 263).

Specific AI technologies will be used to create fully-fledged virtual worlds and to develop functionality and rules, which will contribute to the emergence of various forms of social interaction and communication. In August 2025, Google DeepMind developed the Genie 3 model, which can create dynamic virtual worlds based on text queries, at the same time simulating various conditions for their functioning – from natural phenomena to physics of different environments (*Google DeepMind*, 2025a). In November 2025, Google DeepMind developed a specialized AI agent, Sima 2, which is capable not only of processing natural language and performing specified

actions, but also analyzing them, communicating with users, and getting improved over time (*Google DeepMind*, 2025b).

Each of these technologies will make the experience of presence in the metaverse more authentic and engaging (Jauhiainen, 2024), while enabling an increasing variety of social and community interactions. The development and implementation of XR technologies will continue to blur the boundary between physical and digital worlds, allowing users to maximize their immersive experiences (Cho et al., 2023).

However, it is equally important to acknowledge that access to metaverses will depend on specialized immersive technologies, which may present significant barriers and restrictions for certain population groups. These limitations may be financial, where individuals cannot afford the necessary devices due to high costs, or psychological and cognitive, where some users may struggle to adapt to or understand the new digital reality. This raises critical ethical concerns about “technological discrimination” and the deepening of digital inequality. While some users will gain access to new economic, educational, and political opportunities within the metaverse, others may be excluded, risking the formation of a “digital elite” and, conversely, “digital marginals”. The ethical challenge, therefore, lies in ensuring that metaverses promote social integration rather than becoming tools for exclusion. It is essential to prevent the marginalization of certain groups and to ensure that the benefits of metaverse development are accessible to all, regardless of economic status or digital literacy.

The development of social interaction and the presence of specific forms of social activity in metaverses will largely depend on who participates in their formation and governance, whether they are centralized or decentralized, and on the degree of state control and regulation.

Undoubtedly, particular forms of interaction will also be shaped by the demographic, social, and status-related characteristics of metaverse users. According to available data, as of now, 80% of metaverse users are young people under the age of 16 (Hryziuk, 2024). This demographic profile may influence the nature of social engagement within these spaces. Young users are typically more inclined toward protest behaviors, more open to change, and more likely to participate in actions expressing dissatisfaction with existing policies. In general, statistics indicate that approximately 60% of users utilize the metaverse for non-gaming activities (*ibid*). Moreover, metaverses, by offering immersive experiences, facilitating social learning, and generating a sense of “social presence” and a “realistic environment”, can significantly enhance the effectiveness of social interaction. This, in turn, can lead to the intensification of various forms of social activity and the release of new potential for social communication (Zallio & Clarkson, 2022; Oh et al., 2023).

Current practice shows that most leading virtual realities are created

and controlled by private companies, with few exceptions such as specialized institutional metaverses (e.g., Interpol's metaverse) (Buana, 2023: 23; Coeckelbergh, 2024: 7). The use of AI technologies in metaverses by antisocial actors poses new threats, including tools for influencing mass consciousness and undermining informational and psychological stability (Sebekin & Kalegin, 2023). Particularly concerning is the growing power of Big Tech, whose influence extends beyond commercial interests. Some researchers warn that major tech corporations may attempt to use AI not only to secure their dominance but also to reshape society, exert total control, and suppress dissenting voices (Grinin et al., 2024).

In these conditions, in order to avoid infocratic control over users by Western platforms and their configuration of the global digital space, it is extremely important for the countries of the "world majority" to develop their own sovereign virtual reality platforms and metaverses. In this regard, it is the BRICS that can become a platform where alternative inclusive approaches to managing data, the metaverse platforms themselves, and the global digital space are explored and promoted.

From the standpoint of social interaction, metaverses are becoming a powerful space for shaping informational agendas and exerting informational influence on large target audiences. This can lead to new, and sometimes unpredictable, forms of unification or polarization along ideological, political, social, or cultural lines.

The promising development of new forms of social activity in the metaverse raises important ethical questions regarding the distribution of responsibility for its human-centered and ethical use, among users, developers, platform owners, and the state. As social interaction within the metaverse becomes increasingly complex, new forms of conflict and destructive potential are likely to emerge. Who should be held accountable for harm caused within the metaverse? How should digital crime, virtual violence, fraud, and psychological manipulation be addressed and regulated? The core ethical paradox lies in the need to balance freedom of expression and identity with the protection of individual and societal rights.

3. Conclusion

Over the past decades, metaverses have demonstrated continuous technological advancement and conceptual development. This research has shown that the ongoing evolution of metaverses will further contribute to the emergence and increasing complexity of new forms of social interaction and immersive experience. By their very nature, metaverses unify large numbers of users within a single space, which inevitably gives rise to new forms of social activity.

Summarizing the findings of this study, the following consistent patterns in the evolution of metaverses can be identified:

1. As metaverses develop technologically and conceptually into full-fledged socio-technological spaces, and as the number and diversity of users and actors grow, they create expanding opportunities for both interpersonal and large-scale social interaction, including interactions between corporate entities and individuals. This development leads to increasing complexity in social dynamics. Often, activities within metaverses reflect or respond to events taking place in the real world.
2. The evolution of metaverses marks a shift from purely gaming experiences toward the emergence of more complex and socially significant forms of interaction. Metaverses have become an “alternative” space capable of reproducing forms of social interaction already present in the real world.
3. Social interaction and public activity in metaverses extend across multiple domains of human life, politics, economics, culture and the arts, science and education, public health, and more.
4. The development of metaverses as socio-technological environments, along with the increasing complexity of social and community interaction, has an ambivalent character. It can stimulate innovation and engagement but also generate new high-tech challenges and threats, giving rise to entirely new forms of conflict potential.
5. The perceived realism of social activities in metaverses may have a deep psychological impact on mass audiences, which can be carried over into the real world and produce tangible effects.

Given the rapid technological and conceptual development of metaverses, along with the growing number of users and the emergence of malicious actors, there is a clear need for the appropriate regulation of “meta-social” activity. This regulation must involve the coordinated participation of the state, private companies, and the user community, based on a secure and cooperative partnership among these key stakeholders.

It is essential to recognize that metaverses represent not only a new global socio-technological trend but also a new form of socio-virtual reality, one that has the potential to generate informational, psychological, and social challenges on a global scale. In this context, the development of metaverses requires ongoing, critical analysis by the academic community, as well as the formulation and implementation of ethical principles to guide their safe and responsible use.

Meanwhile, the conclusions made in the article should be considered as a result of theoretical analysis rather than as final formalized assessments. As metaverses develop technologically, become institutionalized, and unleash increasingly more forms of social interaction in the future, it will be possible to provide a more systemic

empirical verification of the conclusions made in this work, as well as the proposed conceptual and theoretical framework.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

All authors contributed to the original idea, study design.

Ethical considerations

The authors have completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc. This article was not authored by artificial intelligence.

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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