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# Metaverse platform ecosystems

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**Abstract**
Traditionally, the metaverse has been defined as a virtual reality space in which users can interact with a computer-generated environment and other users. Nowadays, it is much more than that—the metaverse can be described as a variety of digital platforms and ecosystems, with each ecosystem as an independent universe with its own material, complementors, and functionalities. Creating metaverse ecosystems and integrated platforms results in different roles and responsibilities for complementors, consumers, platform owners, and orchestrators. The term metaverse platforms is further structured and clarified by four perspectives: innovation, production, transaction, and social interaction. Consequently, this fundamental paper defines it as: "A Metaverse is a massively scaled and interoperable meta-ecosystem of other digital ecosystems of real-time rendered 3D virtual worlds which can be experienced synchronously and persistently by an unlimited number of complementors and consumers with an increased user experience caused by a creativity-guided co-creation of goods managed by orchestrators and supported by platform owners." Consequently, the metaverse offers vast opportunities for digital innovations beyond traditional social media or computer games and creates new infrastructures for add-on innovations in all areas of the digital economy.

**Keywords** Metaverse · Platform · Ecosystem

**JEL Classification** M21

## The rise of the metaverse

The metaverse became a trending topic driven by companies and their investments (Dolata & Schwabe, 2023). Facebook purchased the manufacturer Oculus for the deeper development of virtual reality (VR) and augmented reality (AR) technologies, aiming to provide a new customer experience. Microsoft has taken over Activision, one of the biggest developers of online gaming, to prepare for the next level of the internet. The metaverse originated from Neal Stephenson's *Snow Crash*, published in 1992 (Joshua, 2017; Stephenson, 1992), which was, at that time, described as the combination of the word "meta" (meaning beyond) and the stem "verse" from the universe (Dionisio et al., 2013). With rapid technological developments, such as the introduction of blockchains or other related technologies, the development of the metaverse has matured (Duan et al., 2021; Moneta, 2020).

Although the number of publications on metaverse and platforms has increased rapidly, metaverse lacks a commonly accepted and consistent definition (Peukert et al., 2022). Therefore, demystifying the term by relying on the characteristics of the metaverse is required (Peukert et al., 2022). Two scenarios can happen: there is either one metaverse owned by one powerful company, or there is a crypto-based metaverse owned by everyone (Nickerson et al., 2022). It is generally assumed that the first scenario will happen (Ball, 2020; Nickerson et al., 2022). With assumptions about the structure and scenario of the metaverse becoming more precise, it is now possible to get one step further in describing its functionalities by elaborating on what makes its structure different compared to the current platform. The metaverse combines traditional approaches to modeling and simulation

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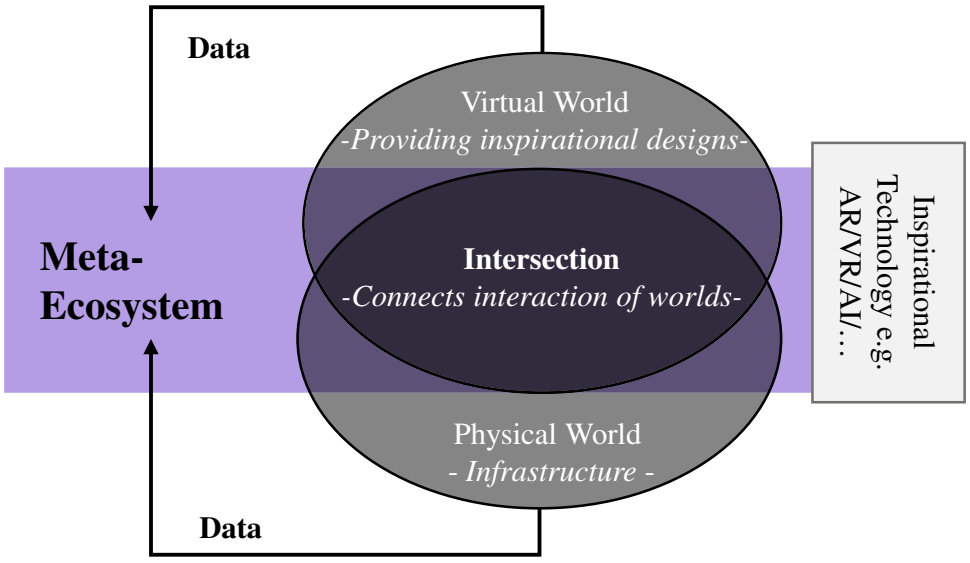


**Fig. 1** Connection between physical and virtual worlds of meta-ecosystems adapted from Duan et al. (2021)

with emergent user dynamics, supporting their creativity and leading to emergent knowledge processes (Huggett, 2020). In other words, the metaverse changes our perspective on designing and managing online platforms and denotes the next type of internet platform ecosystem in which users, represented by avatars, interact with each other and software applications in a three-dimensional (3D) virtual space (Duan et al., 2021). The metaverse goes beyond the tool metaphor of information technology to be a model of the real world and an extension of consumers and complementors (Davis et al., 2009; Sotto, 1997).

This fundamental paper presents the structure and functionality of metaverse platform ecosystems. This differentiation will be done by referring to the role and meaning of actors, the structure of the metaverse, and characteristics by relying on aspects of production, transaction, interaction, and innovation (Thomas et al., 2014). In addition, a definition of metaverse platform ecosystems is presented, and one solution is provided to better specify the characteristics of the metaverse.

The remainder of this fundamentals paper is structured as follows. After motivating this paper, the platform perspective on the metaverse is discussed by explaining changes in the structure of the metaverse. The paper is closed by providing an outlook for the future of the metaverse and a synthesis of the information presented herein.

## Structures and roles of metaverse platforms

The nature of a metaverse is that it seamlessly connects the virtual world with the real (physical) world (Park & Kim, 2022). Figure 1 provides the initial idea behind the metaverse.

The metaverse can be categorized as an ecosystem (meta-ecosystem) that hosts several other ecosystems and platforms (Nickerson et al., 2022). Given the typical structure of platform ecosystems, it is useful to think of a platform ecosystem as an "organization of organizations," that is, a meta-organizational form (Kretschmer et al., 2022). A platform, on the other hand, can be specified as a set of shared core technologies and technology standards underlying an organizational field that supports value co-creation (Hein et al., 2020; Thomas et al., 2014). To provide an ecosystem for the metaverse, the structure of platforms and the responsibilities of integrated actors need to change. The important question is to understand what characterizes metaverse platforms and their integrated actors (Papagiannidis et al., 2008). Existing platforms, ecosystems, and their relationships change, with the metaverse being existent (Ball, 2020). The metaverse can be characterized in two ways. First, the structure is changing. Second, the roles of consumers, platform owners, and complementors are different, also changing how value co-creation and user experience are developed.

The metaverse is the intersection combining the physical and virtual worlds—this intersection can be seen as a meta-ecosystem that inherits many other ecosystems. In other words, the metaverse can be viewed as a variety of digital ecosystems, where each ecosystem can be conceived of as a universe with its own material, complementors, and functionalities (Nickerson et al., 2022). In a metaverse ecosystem, platforms and devices work seamlessly with each other (McKinsey & Company 2022). A visualization is provided in Fig. 2.

Relying on the typical structure of platform ecosystems, an ecosystem can be described as an organization of organizations (Kretschmer et al., 2022). Let us imagine the following scenario: someone wants to buy a property; afterward, he

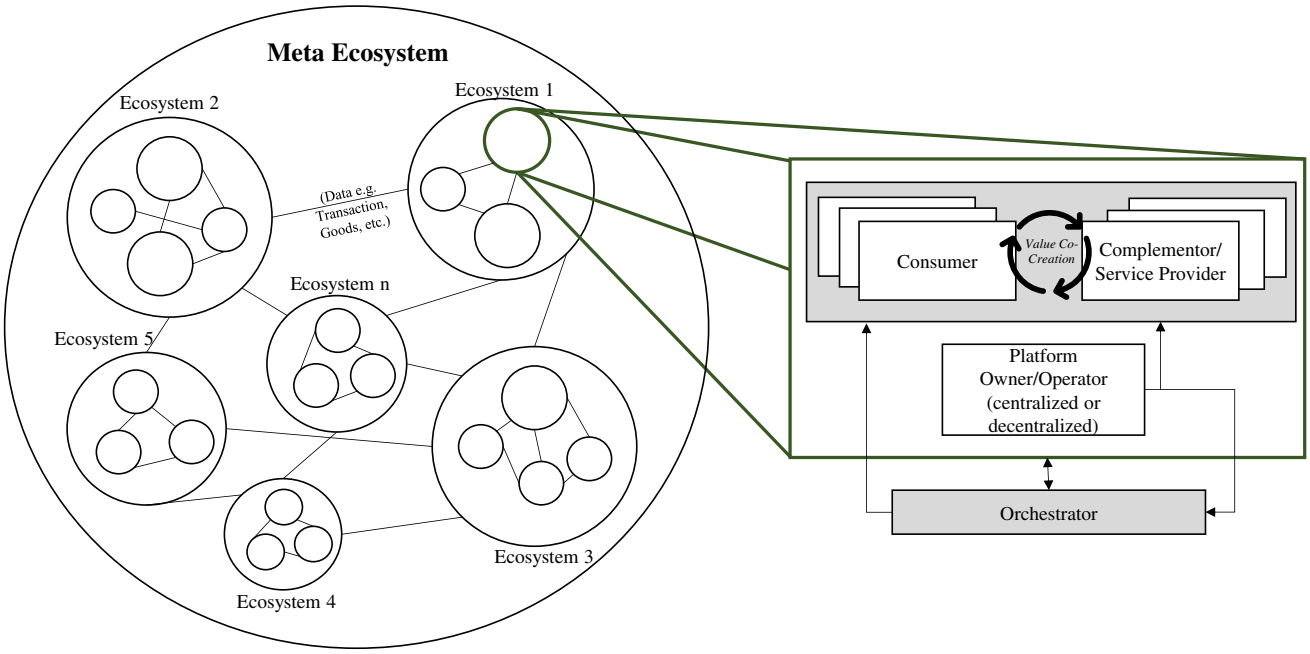


**Fig. 2** Meta-ecosystem and roles

must attend a business meeting for work, and in the evening, he wants to go to a concert with his friends. Everything happens at the intersection—our meta-ecosystem. Referring to Fig. 2, ecosystem 1 could represent Decentraland, ecosystem 2 is Spatial, and the third ecosystem is Fortnite. Our user—represented as a 3D avatar—can switch from one ecosystem to another without any restrictions. In a real-world setting, our user would probably drive from his real estate agent to work. In the metaverse, he just puts on his extended reality (XR) device, enters the meta-ecosystem, and switches from the office of his real estate agent into his own office within seconds, having the same virtual and visual representation all the time.

One important aspect to consider from our example regarding the structure of metaverse platforms is how the transfer from one ecosystem into another can happen and what is necessary for it. It also involves a discussion of who is going to take care of this aspect and what is part of this transfer. Once entering, everyone will be able to overcome platform-specific boundaries and can freely move across platforms—this can be described as interoperable cross-platform persistence—thus switching from a business meeting situation to a concert or back to a shop to buy something.

Typically, a platform needs complementors or, in other words, service providers, a platform owner, and consumers to work (Hein et al., 2020). In a metaverse, consumers are also becoming complementors, and complementors are becoming creators. In this constellation, value is created not only by the interaction of platform owners and complementors. Value is co-created by the interactions and activities between complementors and consumers. The platform owner (either centralized or decentralized (Nickerson et al., 2022)) and the complementors split control rights related to their joint value-generating activities (Kretschmer et al., 2022). The complementors contribute their own creativity and functionalities. These functionalities can be any form of content that has been created by them, and exclusively by them, rather than the owners of platforms that provide functionalities to them (Duan et al., 2021). Thus, platform owners do not provide any content; they need to provide the room and resources to allow for freedom and creativity, with each functionality connected to a complementor; various combinations create value, and users experience results. Complementors do not follow the rules of a platform owner; they create their own (e.g., nonfungible tokens (NFT)). Hence, the complementor in the metaverse tends to be heterogeneous and requires ownership (Duan et al., 2021).

This leads to another change in the meta-ecosystem. The role of platform owners changes, and another actor, who has a different but very important role, is becoming more relevant. Platform owners are operators who run a platform but do not make changes. In Fig. 2, each circle represents an ecosystem that is part of a larger and overarching meta-ecosystem. To allow for interoperability and guarantee the persistence of, for example, goods and transfer data (e.g., involving transactions), we need what we call an orchestrator. For a metaverse, one must decide on an interface, such as an application programming interface (API), which becomes

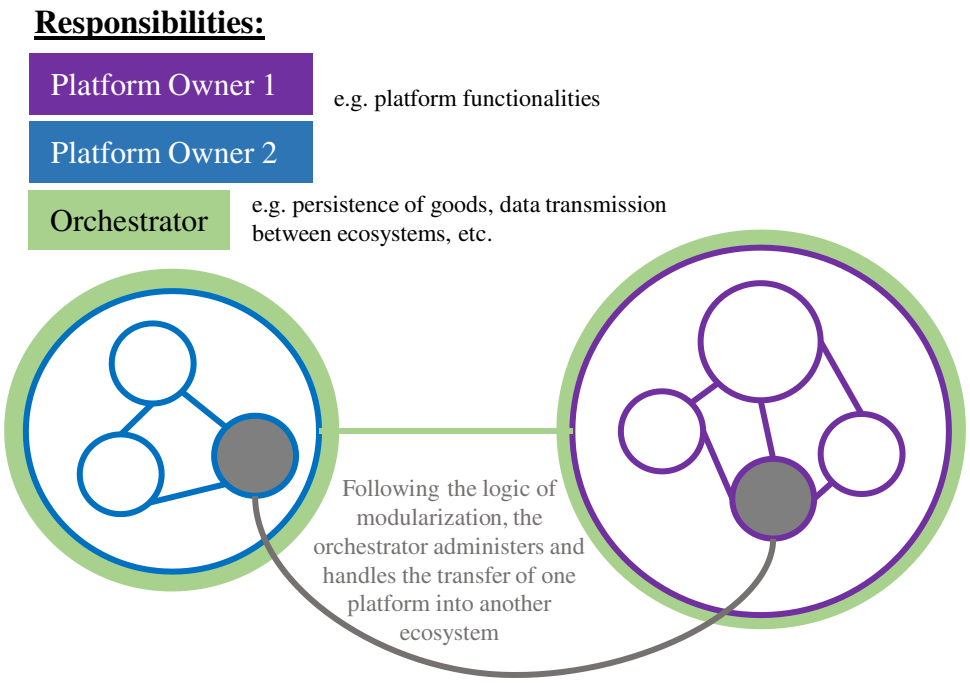


**Fig. 3** Roles of owners and orchestrators

the standard for coordination, making it a technical decision (Nickerson et al., 2022). The orchestrator acts as an API layer that can hook all parts of the metaverse ecosystems and platforms. The responsibilities of platform owners and orchestrators are visualized in Fig. 3.

The orchestrator enables the transfer of one component or platform from one ecosystem to another ecosystem—similar to what we know as modularization (Cenamor et al., 2017). The orchestrator can be seen as the technical manager of the meta-ecosystem. A metaverse orchestrator is needed for the metaverse because if one part of the metaverse is adopted, it needs to be changed in all ecosystems and integrated platforms. Outsourcing changes to platform owners make it hard to maintain, resulting in mistakes, and limit standardization and automatization (Smedlund et al., 2015). With such an orchestrator, platform owners do not need to deal with every part of the setup and the changes that happen. The platform owner can see the complete underlying structure and determine the key functionalities and designs of the platform. For example, as owners of a gaming world, they specify the purpose of the game—that is, being part of one or more ecosystems in the meta-ecosystem. A meta-ecosystem and its integrated platforms rely on blockchain technologies; thus, control over data will become peripheral, preventing top-down data mining and delegating data policies to external authorities, such as orchestrators, that need to promote the adoption of common rules for data security, privacy, and confidentiality (Marabelli & Newell, 2022).

With a description of the actors that are part of metaverse platforms and their ecosystems, the two scenarios presented at the beginning can be specified in more detail. As described by Nickerson et al. (2022), there is either one organization that offers one metaverse for everyone, or there are several metaverses. To realize the first scenario, a platform owner or operator and an orchestrator are needed. This scenario is displayed in Fig. 3. With several metaverses, there is a change in the actors' responsibilities. The platform owners act as operators and fulfil the tasks of orchestrators. Therefore, the owner is either centralized or decentralized.

The critical question is, with changing roles, responsibilities, and structures of metaverse platform ecosystems, we also need to rethink governance structures. In general, the governance structures of a platform can be understood as follows: they refer to all policies, rules, and mechanisms through which all participants are coordinated in an ecosystem (Song et al., 2018). Aspects of relevance involve pricing, the coordination and control of platform participants, and rules (Song et al., 2018). Typically, in organizational settings, we are confronted with hierarchical decisions that differ in platform ecosystem environments. Platform ecosystems involve different stakeholders, such as consumers and owners, who split control rights to create value through a joint effort (Kretschmer et al., 2022). With the existence of metaverse platform ecosystems and changing roles and responsibilities, we also have to rethink governance structures. The governance structures of metaverse platform ecosystems can be better described from two perspectives: governance by the metaverse and governance of the metaverse (Dwivedi et al., 2022). Governance by the metaverse involves rules to guide the behaviors of all involved stakeholders. Looking at our previously described roles, we can argue that the

orchestrator creates and handles such rules, which allow him or her to arrange and instantiate security concepts, as well as billings and payments. However, the existence of rules in relation to metaverse platform ecosystems has been critically discussed; some even say that rules do not exist in metaverse platform ecosystems (Rosenberg, 2022). Looking at the initial definition of the metaverse as a digital representation of our real world, we can say that our real world does not work without rules being existent. This is reflected in the governance of the metaverse, which involves things we cannot program, such as in the real world, where rules can be broken (Dwivedi et al., 2022). This aspect, in turn, is handled by platform owners and complementors. Metaverse platform ecosystems have an evolving nature and dynamic governance structures (Dwivedi et al., 2022), making someone such as an orchestrator even more relevant.

To better point out the meaning of metaverse platform ecosystems, we next discuss their characteristics using a classification of platforms provided by Thomas et al. (2014). We explain how goods are produced, innovations are created, transactions are handled, and how interaction changes once metaverse platform ecosystems have been established. These aspects and related characteristics are elaborated on in the following section.

## Producing goods in the metaverse

Producing goods is about the use of a collection of assets and an interface that enables the sharing of these to scale and scope (Thomas et al., 2014). The production of goods involves retailing. Historically, traditional retailing customers have been interested in customer service and are product-oriented (McGoldrick, 2002). With electronic commerce and more retailers acting online, users can check for prices and have a wider choice of selecting products, making selling and offering products online more customer-oriented (Esmeli et al., 2021; Kim, 2002).

Competition between platforms typically involves how platforms use prices, investments in quality, and subsidization or provision of complements (Kretschmer et al., 2022). With meta-ecosystems and their sub-ecosystems, competition changes. Within a metaverse, consumers can easily switch between ecosystems and compare prices. Typically, complementors provide goods to the ecosystem. In each metaverse ecosystem hosting different platforms, the content produced is created by complementors who are, at the same time, consumers (Ondrejka, 2005). In other words, the production of any kind of good occurs in the world, so there is no separate pre-approval process to inhibit goods (Ondrejka, 2005). The meta-platform orchestrator does not administer only one ecosystem. The meta-ecosystem is designed in a way that connects several ecosystems, each with another focus, for example, a gaming platform or an e-commerce platform. Each platform owner provides details of the platform's nature to the orchestrator. Complementors provide functionalities that can be connected and combined in different ways across different platforms and transferred to different ecosystems.

The production of goods involves the creation of value. In metaverse platform ecosystems, value is created by the generated goods, but it is not up to an interaction between the platform owner and the complementor alone. It is between complementors and customers. Value is also created by enabling the persistence of goods between ecosystems, leading to a better user experience—for example, someone buys a bag, and this bag remains the same along all ecosystems that are integrated into a metaverse. User experience can be understood as "a user's perceptions and responses resulting from the use and/or anticipated use of a product, system, or service" (International Organization for Standardization, 2010). User experience is dynamic and context-dependent, which implies that it is contingent on the usage context, incorporating factors such as time, place, and purpose (Law et al., 2009).

A platform that is part of any ecosystem in the meta-ecosystem is characterized by flexibility, making it easier not only to create goods but also to modify objects quickly and support another level of personalization and individualization of products. Each user can create his or her own room individually. Unlike gaming platforms, an ecosystem is not fixed and can be freely modeled and altered by users (Getchell et al., 2010).

## Managing metaverse platform transactions

Platform transactions involve the manipulation of market pricing mechanisms and market access; they extract the surplus value generated by leveraging the platform's position as a valued hub that links multiple sides of the market (Thomas et al., 2014).

A platform that is integrated into a meta-ecosystem has the potential to dramatically open larger markets because it provides users with the vibrant dynamic of a physical world setting (Ondrejka, 2005). The meta-ecosystem can be characterized as a multi-sided market (Alt, 2020), with transactions that involve more than one partner and combine several ecosystems and their integrated platforms. Consequently, one characteristic of transactions is that one currency is needed that is valid and usable for all integrated ecosystems of the meta-ecosystem (Papagiannidis et al., 2008). The ones that are connected with a transaction in a metaverse are the complementors and consumer avatars that somehow order a product, such as an article of clothing, and who pay, for example, with Ethereum (ETH). Depending on the scenario

that will happen, as displayed by Nickerson et al. (2022), the metaverse will rely on blockchain technology.

ETH is a platform powered by blockchain technology that is best known for its native cryptocurrency, which is essential for a metaverse because it is its currency and how payments are arranged. Related work on metaverse platforms indicates that cryptocurrency is the economic bridge between integrated ecosystems as well as between each ecosystem and the real world. Cryptocurrency is used for NFTs as a means of payment and is based on ETH and smart contracts (Dowling, 2022). One can question whether those trading cryptocurrencies are the leading traders of NFTs and thus will lead to inefficiencies in pricing behaviors, similar to early developments of cryptocurrencies (Urquhart, 2016).

### Social interaction on metaverse platforms

Social interaction in the metaverse happens as a real-time interaction allowing an interaction of thousands of users (Choi & Kim, 2017; McKinsey & Company 2022). To allow for such interaction, platform orchestrators need to provide different possibilities for interacting with other users and between ecosystems. With metaverse ecosystems and their platforms, new forms of social interaction result because users can share social interactions without restrictions on the physical world (Forte et al., 2010). In other words, interaction happens in an integrated network environment rather than in an isolated virtual world (Huggett, 2020). On a metaverse platform, individuals can interact simultaneously with different kinds of communication channels (Getchell et al., 2010; Owens et al., 2011). Interaction happens when avatars interact with others' avatars. These avatars create a social presence, which is the sense of being with one another in a mediated environment (Duan et al., 2021). An avatar is created as a real-life 3D scan to digitally represent someone very close to the physical world representation, thus integrating immersive technology. Social interaction happens via the facial expressions of avatars and through tone, voice, or text messages (Duan et al., 2021). In social communication, relevant applications that require remote presence, as well as facial and motion characteristics reflecting the physical human condition, are essential (Lee et al., 2021).

### Creating innovations on a metaverse platform

Innovations facilitate the creation of new goods and services that were not existent yet (Thomas et al., 2014). It distributes self-interest decision-making across an ecosystem by improving older components and by replacing them with new ones (Thomas et al., 2014).

With existing platforms, such as social media and e-commerce platforms, we can support economic and social activities. The roles of consumers and complementors, who have more autonomy in creating their own goods and thus support their creativity and self-expression, change with the metaverse (Papagiannidis et al., 2008). Simply saying, it is not only companies that are acting as retailers in the metaverse but also the individual artists who can create goods on their own. Additionally, innovations follow a logical evolutionary path (Wiesböck & Hess, 2020). From this perspective, creating innovations does not only involve creating new products; it also involves structural changes in business models (Wiesböck & Hess, 2020). Therefore, innovation in metaverse platform ecosystems happens in two different ways: (1) by supporting creativity and (2) by providing options to experiment, hire people, and collect feedback (Dwivedi et al., 2022). The first scenario can be explained by the changing roles of complementors and consumers. Regarding the first aspect (1), we can say that so far, innovations cannot happen in the metaverse because complementors are reusing content provided by platform owners, and there is no added value in the way real-world creation allows for creativity (Ondrejka, 2005). In a metaverse, complementors provide goods and functionalities that can be combined in many different ways, resulting in value and user experience. This aspect can be better understood if we look at NFTs. They are connected to blockchain technology and smart contracts. Besides the role of blockchains in relation to NFT, they have a different role, involving innovations that happen digitally. NFTs are digital assets, such as images, videos, songs, or pieces of virtual land, that primarily trade through a metaverse online market (Dowling, 2022). Similar to missing groundwork involving the metaverse, NFT pricing has not been part of many research studies, regardless of its exponential growth rate (Dowling, 2022). With the full creativity provided to complementors, along with a platform and market to sell their goods, new ground for innovation is created. From a technical perspective, goods generated on a metaverse platform need to be persistent. If a user has bought, for example, a bag, and he or she keeps it on all platforms, it remains the same. This is a technical challenge that will be addressed by a platform orchestrator.

Regarding the second aspect of creating innovations (2), we target the roles of platform owners and organizations that differ in metaverse platform ecosystems. By definition, we can do everything in the metaverse that we are doing in our real world but without less severe consequences and dangers (Schöbel & Tingelhoff, 2023). For example, the metaverse platform ecosystem provides a realistic real-world environment in which organizations can run prototyping tests without losing materials and resources that they lose in the real world (Schöbel & Tingelhoff, 2023). Additionally, it is easier

to collect feedback and employ the right persons (Dwivedi et al., 2022). In short, metaverse platform ecosystems provide better grounds for creating innovations by offering full creativity to complementors and users (1) and allowing room to collect feedback, save costs, and avoid risks prior to realizing any kind of goods in the real world (2). For both, one important characteristic of metaverse platform ecosystems is immersion (Vernaza et al., 2012). Digital immersion involves technologies such as AR, VR, mixed reality, and XR, which support us in experiencing more realistic activities (Barry et al., 2015; Park & Kim, 2022; Wright et al., 2008).

## Synthesis and critical reflection on metaverse platform ecosystems

One question remains: Are we there yet? Do we already have the metaverse, and in accordance, is there going to be one big metaverse, or do we get several smaller ones? Although we seem to be not there yet, the picture of what a metaverse could be is getting more precise, nonetheless because of the large number of research studies that have been published during the last few months. For example, research studies have characterized the metaverse with taxonomies (Park & Kim, 2022), enabling us to specify the structure and requirements that we need to fully apprehend the metaverse. With an ongoing debate on the existence of metaverse platform ecosystems, in our paper, we provide some clarity by highlighting that the structure of ecosystems and platforms and the roles of actors change. With this in mind, and looking at the structural differences of the metaverse, aligned with Ball (2020), we provide the following definition of metaverse ecosystems and their platforms:

> *A metaverse is a massively scaled and interoperable meta ecosystem of other digital ecosystems of real-time rendered 3D virtual worlds that can be experienced synchronously and persistently by an unlimited number of complementors and consumers with an increased user experience caused by a creativity-guided co-creation of goods managed by orchestrators and supported by platform owners.*

The metaverse allows us to explore, create, socialize, and participate in a wide variety of experiences, from business meetings to buying something or attending a concert. The businesses taking place in the metaverse are differentiated from traditional online experiences and multiplayer video games by the existence of a large ecosystem of complementors that act as content creators, which generate most of the content and collect the majority of revenues built on top of the underlying platform. The key to realizing a successful metaverse is interoperability. Interoperability remains a key feature of the metaverse, and without solid agreements between ecosystems, the metaverse—a persistent virtual experience—is not likely to happen (Marabelli & Newell, 2022).

As discussed earlier, two scenarios can occur that determine the roles and responsibilities of platform owners and orchestrators. First, large companies purchase smaller companies and generate synergies between ecosystems and integrated platforms, such as Facebook and Instagram. Here, one powerful company will own the metaverse, which is the most likely scenario (Marabelli & Newell, 2022). The second is the creation of multiple metaverses, such as Google and Apple, where users decide how to integrate their technology and pick just one vendor. Nonetheless, for both scenarios, the roles of complementors, platform owners, orchestrators, and ecosystems are going to change.

Aligned to the changing nature of platforms toward transferring them to the metaverse, it is interesting to discuss the next level of data ecosystems surrounding the metaverse, which is part of an operator's work. To date, the global cloud storage volume has involved 1024 petabytes of data. A metaverse requires a lot more data, much of which results from the integration and interaction of diverse technologies, such as VR, AR technology, blockchain, avatar interaction, and integration of social media platforms. Hosting and handling metaverse ecosystems and their platforms requires significantly more effort than organizing traditional two-sided market platforms -Airbnb is an example of this.

A metaverse involves many different complementors and platform owners, a fact that critically questions Mark Zuckerberg's promise of a unified metaverse. Transactions and establishing smart contracts and blockchains in the metaverse will require a more detailed analysis of legal aspects. Typically, a blockchain is platform software that matches the demands of different organizations. With the metaverse, blockchain technology and NFTs have initiated new discussions involving smart contracts to determine an NFT's originality and to support designers in protecting their work so that nothing can be easily copied by others. Therefore, new approaches are needed to better protect privacy-related data and created goods (Bandara et al., 2020).

## Outlook for future research

To this end, we aim to provide three avenues for future research. To provide implications for future research, we want to provide some examples and critical reflections on where we are located at the moment in understanding metaverse platform ecosystems from a research perspective.

After Meta triggered the existence of metaverse platforms, several other platforms were handled as "the metaverse." For

example, one platform that is often discussed in relation to the metaverse is Second Life. In research, Second Life has already been declared metaverse but has failed due to unknown reasons (Inman et al., 2010). Other examples are Decentraland,[1] Roblox,[2] Fortnite,[3] Cryptovoxels,[4] and the Nth Floor.[5] The question here is what makes these platforms special and different from other platforms such that they are referred to as metaverse platforms. The obvious and simple answer to this is that these platforms offer characteristics that are generally important for metaverse platform ecosystems. A more detailed answer would involve a discussion of which characteristics are needed from an organizational perspective to make metaverse platform ecosystems happen. Fortnite, Decentraland, and Roblox are owned by large gaming companies. By collaborating with such platforms, organizations are taking one step toward the metaverse—they invest in a 3D - oftentimes immersive - platform and have a structural setting that makes it easier for them to enter the metaverse. Each platform that is currently discussed as "the metaverse " has its own advantages e.g., some offering a blockchain environment, others offering an immersive environment, and still others offering an e-commerce setting (Bourlakis et al., 2009). All these platforms are common in that they need further investments and changes to be a part of metaverse platform ecosystems. In the end, we need to join and connect all platforms and make them compatible by offering, for example, one payment and one design. Consequently, the guiding question is as follows: What do we need to change to make existing platforms compatible and worth acting in a metaverse platform ecosystem? Therefore, the first initial area for future research guiding all of our other implications for future research is the following:

**Provide a description of metaverse platform ecosystems:** Such a description of metaverse platform ecosystems does not necessarily involve the development of taxonomies -which we already have Park & Kim, 2022. Rather, it involves research that explains and elaborates on how organizations can become a part of metaverse platform ecosystems (Schöbel et al., 2023). In other words, research needs to clarify what organizations and thus platform owners need to do with their current platforms. This involves questions on which characteristics they need to change, how they need to change them, and how they need to transfer their business models (Schöbel et al., 2023). Therefore, and aligned with our recommendations about the structure of metaverse ecosystems and the changing roles and responsibilities, we suggest the following areas for future research that will assist us in better elaborating on how we can better realize metaverse platform ecosystems.

**Full creativity for metaverse complementors:** The vision of the metaverse is that everyone can create and merchandize content without limiting creativity (Dwivedi et al., 2022). This presents some challenges in terms of platform governance, especially for platform owners and orchestrators. Future research needs not only to explore the role of orchestrators and their tasks and responsibilities for both scenarios but also to explore how far we can go in terms of removing rules for complementors. Such creativity is allowed by an open platform ecosystem. However, with an open platform ecosystem, platform owners would need to adopt governance features to avoid the so-called "Atari shock" (Kretschmer et al., 2022)—known from the video game crash in 1983, which was a large-scale recession of video games because of poor product quality. Accordingly, future research needs to explore guidelines for platform owners that provide creativity on the one hand and guarantee the quality of produced and offered goods on the other hand. Additionally, the role of orchestrators needs to be further explored in their task of managing and handling data- and technology-related challenges.

**Establishment of governance structures:** With a combination of different ecosystems and platforms, several aspects should be discovered in future research studies. Considering that there is governance of the metaverse and governance by the metaverse (Dwivedi et al., 2022), several questions need to be answered. Among others, the emergence of platforms should be explored, as well as the interaction with competing complementors. Furthermore, questions remain regarding incentive structures for participation, platform governance, and incentive structures for customer participation (Kretschmer et al., 2022). Future research needs to consider and discuss how and if government structures can be developed, considering both the perspectives of governance of and by the metaverse. In particular, the relationship between platform owners and orchestrators and the autonomy of complementors should be a part of future research analyses.

**Privacy and data-related issues:** Caring about privacy issues may be a complex but necessary part of ensuring that consumers and complementors have a good user experience (Nickerson et al., 2022). With the platforms being existent and used actively, organizations will be able to collect granular data on how consumers behave, resulting in new dangers involving, among other things, hate speech (Marabelli & Newell, 2022). Meta, for example, is working on a

[1] https://decentraland.org/.

[2] https://www.roblox.com/.

[3] https://www.epicgames.com/fortnite.

[4] https://www.voxels.com/.

[5] https://www.accenture.com/us-en/blogs/how-accenture-does-it/are-you-ready-for-close-encounters-of-the-virtual-kind.

technological solution that can detect the emotions and feelings of individuals (Heilweil, 2021), which will compromise individuals' privacy. Future research needs to explore and develop concepts that consider scenarios of what happens if a metaverse is hacked or which data are collected, as well as how we can protect data from fitness trackers or sensors, how data lakes are handled, and how the data are managed (Wong, 2021).

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