

# Experimenting on the metaverse to foster innovation

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## Abstract

**Purpose** – This study aims to investigate the evolving concept of the metaverse and its implications for service innovation. It seeks to understand how integrating technologies such as extended reality, blockchain, artificial intelligence and non-fungible tokens enables companies to experiment and innovate.

**Design/methodology/approach** – Adopting a qualitative methodology, this investigation conducts an immersive netnography across more than 25 case studies spanning diverse industries such as gaming, retail, health care and education. The thematic analysis method is used to distill critical insights, providing a deep dive into the technological enablers, innovation processes and market adaptations within the metaverse.

**Findings** – The study addresses four main building blocks through which companies experiment with the metaverse to foster innovation: enabling virtual identities' agency, developing non-fungible tokens, designing immersive paths and crafting phygital microworlds. They shape the metaverse by enacting actors, resources, processes and phygital ecosystems. Companies obtain learning outcomes from such experimentation and identify learning challenges.

**Originality/value** – This research contributes to the nascent body of knowledge on the metaverse and service innovation by providing a comprehensive framework that encapsulates the multifaceted ways companies experiment within the metaverse. It extends the understanding of digital-physical convergence in service research, offering theoretical and practical insights into the development of phygital service ecosystems.

**Keywords** Metaverse, NFTS, Immersive paths, Phygital microworlds, Virtual agencies

**Paper type** Research paper

## Experimentando en el metaverso para fomentar la innovación

### Resumen

**Objetivo** – Este estudio tiene como objetivo investigar el concepto en evolución del Metaverso y sus implicaciones para la innovación en servicios. Busca comprender cómo la integración de tecnologías como la realidad extendida, la cadena de bloques, la inteligencia artificial y los tokens no fungibles permite a las empresas experimentar e innovar.

**Diseño/metodología/aproximación** – Adoptando una metodología cualitativa, esta investigación realiza una netnografía inmersiva a través de más de 25 estudios de casos que abarcan diversas industrias como los juegos, el comercio minorista, la atención médica y la educación. Se emplea el método de análisis temático para destilar conocimientos críticos, brindando un profundo análisis de los habilitadores tecnológicos, los procesos de innovación y las adaptaciones al mercado dentro del Metaverso.



**Resultados** – El estudio aborda cuatro bloques principales a través de los cuales las empresas experimentan con el Metaverso para fomentar la innovación: habilitar la agencia de identidades virtuales, desarrollar tokens no fungibles, diseñar senderos inmersivos y crear micromundos físico-digitales. Estos dan forma al Metaverso mediante la actuación de actores, recursos, procesos y ecosistemas físico-digitales. Las empresas obtienen resultados de aprendizaje de dicha experimentación e identifican desafíos de aprendizaje.

**Originalidad** – Esta investigación contribuye al cuerpo de conocimiento incipiente sobre el Metaverso y la innovación en servicios al proporcionar un marco integral que encapsula las diversas formas en que las empresas experimentan dentro del Metaverso. Amplia la comprensión de la convergencia digital-física en la investigación de servicios, ofreciendo ideas teóricas y prácticas sobre el desarrollo de ecosistemas de servicios físico-digitales.

**Palabras clave** Metaverso, NFTs, senderos inmersivos, Micromundos físico-digitales, Agencias virtuales

**Tipo de artículo** Trabajo de investigación

在元宇宙中进行实验以促进创新

### 摘要

**目的** – 这项研究旨在探讨元宇宙概念的演变以及其对服务创新的影响。其目标在于深入理解通过整合增强现实、区块链、人工智能以及非同质化代币等技术,如何使企业得以进行实验和创新。

**设计/方法/途径** – 本研究利用定性研究方法,进行了一项沉浸式网络民族志调查,涵盖了跨越游戏、零售、医疗保健和教育等多个行业的25多个案例。通过主题分析方法,提炼出关键见解,深入探讨了元宇宙内的技术驱动因素、创新过程和市场适应性。

**结果** – 这项研究以四个主要方面为切入点,探讨了企业在元宇宙中促进创新的方法:启用虚拟身份的代理、开发非同质化代币、设计沉浸式路径以及打造物理-数字微观世界。通过这些措施,企业塑造了元宇宙,涉及行动者、资源、过程和物理-数字生态系统的执行。在此类实验中,企业积累了丰富的学习经验,并面临了

**原创性** – 本研究旨在建立一个全面的框架,以拓展关于元宇宙和服务创新的新知识,揭示企业在元宇宙中进行实验的多方面方式。它不仅扩展了服务研究领域中的数字与物理融合的理解,还提供了有关发展物理-数字服务生态系统的理论和实践见解。

**关键词** 元宇宙、NFTs、沉浸式路径、物理-数字微观世界、虚拟代理

**文章类型** 研究型论文

## Introduction

The term “metaverse” emerged in 1992 in Neal Stephenson’s (1992) science fiction book *Snow Crash*, in which the author envisioned a future internet-based virtual reality (VR). However, it was not until 2021 that this word gained momentum after Facebook founder Mark Zuckerberg’s affirmation, which caused an exponential increase in Internet searches and debates. In 2022, investment in the metaverse space valued at approximately \$120bn, and experts forecast that the metaverse’s value could reach \$5tn by 2030. The world faces a “genesis trend” (Gartner, 2022), an investment phenomenon that occurs when technology or the market grows sufficiently to trigger a significant and lasting change.

The metaverse is a complex and evolving concept. Ball (2022) defined it as a large-scale interoperable network of real-time three-dimensional (3D) virtual worlds that can be experienced synchronously by an unlimited number of users, with their sense of physical presence and continuity of data (identity, history, communication and payments). Multiple technologies are necessary to build a metaverse. Firstly, it comprises some extended reality (XR) – that is, augmented reality (AR), mixed reality (MR) or VR – as they play a crucial role in making platforms fully immersive, influencing the way individuals interact with products, services, organisations and other users (Dwivedi *et al.*, 2022). In addition, a metaverse includes other technologies, such as blockchain (BcT), artificial intelligence (AI), the Internet of Things

(IoT) and non-fungible tokens (NFTs). They give rise to independent virtual worlds as alternative realms for human interactions (Dionisio *et al.*, 2013).

Use cases of the metaverse have been increasing, though most are on gaming platforms such as Fortnite and Roblox. Other applications are avatar-based team collaboration, virtual prototyping in manufacturing and virtual showrooms in retail (e.g. the Virtual Home Experience proposed by IKEA). Governments are also experimenting with the metaverse; for example, Seoul presented a five-year metaverse Seoul Basic Plan, which would start with constructing a virtual mayor's office and a Seoul campus town (Hazan *et al.*, 2022).

As a result of this increasing use, the metaverse concept has attracted the attention of many scholars, especially in information and communication technology. The trend analysis shows that the number of articles on metaverse peaked around 2010, coinciding with the emergence of the first decentralised blockchain (Bitcoin blockchain); the number then declined and rose again during 2020–2021. However, interest in the metaverse as a research topic in business management grew only from 2022 onward (Mehta *et al.*, 2023). Main studies converge in their view of the metaverse as a cutting-edge set of technologies (Dwivedi *et al.*, 2022; Qamar *et al.*, 2023). These studies provide a structural perspective on the metaverse, identifying its key features and mapping its potential domains in a variety of fields (e.g. retail, tourism and logistics), where it can offer radical innovation (Buhalis *et al.*, 2023; Russo *et al.*, 2024).

However, focusing solely on technology is a limitation and can reveal opportunities and challenges for market innovation. This study aims to investigate the evolving concept of the metaverse and its implications for service innovation. It seeks to understand how the integration of technologies such as XR, blockchain, AI and NFTs enables companies to experiment and innovate. By building on a service perspective, we frame our research question: How do service providers experiment on the metaverse to foster innovation?

We conducted empirical research on over 25 use cases across businesses (e.g. fashion, gaming, tourism and automotive) to explore how companies innovate beyond virtual-to-virtual, physical-to-digital and digital-to-physical. We observed several emerging dynamics and found companies' approach to the metaverse to be changing and complex.

Our main contribution addresses how companies experiment with what can be defined as a proto-metaverse (Xu *et al.*, 2022): an initial state of real-time interactivity, human agency and a sense of immersion. Such a metaverse emerges as an innovative phygital ecosystem in which various actors connect, collaborate, buy and experience by exchanging and integrating various resources. Specifically, we provide a framework based on four foundational elements depicting how companies experiment with the metaverse: enabling virtual identities' agency, developing NFTs, designing immersive contexts and paths and crafting phygital microworlds. They shape the metaverse by enacting actors, resources, processes and ecosystems.

## Literature review

### *Experimentation and innovation*

Experimenting is at the heart of innovation processes (Thomke, 2003). The business literature is rich with studies on how companies develop, test and learn practices to keep pace with market and technology challenges. However, the field has scant knowledge of emerging phenomena (e.g. the metaverse), and a developed framework needs to be present. These factors are critical in understanding highly uncertain experimentation (Gillier and Lenfle, 2019).

As Thomke (2003, p. 1) highlights, "Experimentation matters because it fuels discovery and creation of knowledge and thereby leads to the development and improvement of products, processes, systems, and organisations". While experimenting, innovators look less at the

outcomes, as they are immersed in the process, to understand what works and does not and what needs to be changed. Failure is an occasion to learn. By adopting a broader perspective, some studies address how uncertainties spread in the innovation ecosystem, spurring companies to conduct collective learning experiments and frame a standard template (de Vasconcelos Gomes *et al.*, 2018). By adopting complementary or overlapping roles, multiple actors cooperate and joint experiments offer new value propositions to users and business models.

Technological advances make experimentation more feasible, reducing time and costs and accelerating companies' learning curve (Mele *et al.*, 2023). They offer the potential to unlock innovative service provision thanks to new products, processes and contexts. New actors appear in the market, offering opportunities to exchange or integrate resources. Experimentation transcends the organisations and makes ecosystems the venue where innovation occurs (Mele and Russo Spena, 2017). New exploitation and exploration practices allow knowledge creation and adaptation to different actors, processes and contexts (Mele *et al.*, 2021). Companies struggle to become orchestrators and set up the "contexts and conditions that improve the flow of actions and the process of resource integration" (Mele and Russo Spena, 2015, p. 47). To achieve these aims, they overcome individual uncertainties and "collective uncertainties that also affect members of the innovation ecosystem" (de Vasconcelos Gomes *et al.*, 2018, p. 164).

Experimenting is carried out through an open process (Chesbrough, 2003) that involves the market and technological sides to reduce the uncertainty of the diffusion rate (Mele *et al.*, 2021). A lack of past experiences can negatively affect product familiarity and knowledge, making it challenging for companies to persuade potential clients of the advantages of new technical advancements (Wagner *et al.*, 2017). In this advancement, the context and processes for companies in which experiments deploy widen, as in the case from physical to virtual to phygital to the metaverse (Mele and Russo Spena, 2022, 2024). However, how companies experiment on the metaverse has yet to be discovered.

#### *Metaverse: a definition*

Metaverse refers to 3D, immersive virtual worlds (Davis *et al.*, 2009). Some studies more narrowly define it as a multi-user environment merging physical reality with digital virtuality (Dionisio *et al.*, 2013; Park and Kim, 2022) that enables users to move seamlessly between them for various purposes, such as working and training, exploring interests and socialising with others (Buhalis *et al.*, 2023). The metaverse provides new opportunities for business innovation and creativity (Kraus *et al.*, 2022) by proposing experiential value that can influence brand perception and behavioural responses of consumers (Wongkitrungrueng and Suprawan, 2023). It supports a vision of an immersive internet that is a vast, persistent, shared and unified realm (Lee *et al.*, 2021) being adopted in different domains, such as retail (Bourlakis *et al.*, 2009), culture (Choi and Kim, 2017), education (Kye *et al.*, 2021), health care (Wiederhold, 2022), entertainment (Chia, 2022), the fashion industry (Joy *et al.*, 2022) and tourism (Buhalis *et al.*, 2023). However, consensus needs to be improved, and considerable ambiguity surrounding the metaverse and its scope is evident. Scholars have proposed many definitions in recent years to highlight different aspects of the phenomenon; avatar, 3D, XR, AR and VR represent essential components (Table 1).

An initial definition proposed by Davis *et al.* (2009) covers five key aspects: the metaverse itself, people as users that interact through avatars, technology capabilities involving the ways of communicating and interacting, behaviours manifested through avatars' interactions and outcomes (i.e. member support, perceived quality, self-image, cultural synchronicity, deception, intent to immerse and reconnect anxiety). Studies show opportunities and challenges (Koohang *et al.*, 2023) to open and develop new virtual markets

| Authors                              | Definition  | Main concepts  |
|--------------------------------------|---|--|
| Smart <i>et al.</i> (2007, p. 4)     | “The convergence of virtually enhanced physical reality and physically persistent virtual space”  | Extended reality   |
| Davis <i>et al.</i> (2009, p. 91)    | “Metaverses are immersive three-dimensional virtual worlds (VWs) in which people interact as avatars with each other and with software agents, using the metaphor of the real world but without its physical limitations”   | Extended reality<br>Avatar<br>Digital humans                             |
| Dionisio <i>et al.</i> (2013, p. 40) | “A fully immersive three-dimensional digital environment in contrast to the more inclusive concept of cyberspace that reflects the totality of shared online space across all dimensions of representation”   | Extended reality<br>3D   |
| Damar (2021, p. 1)                   | “A 3D virtual shared world where all activities can be carried out with the help of augmented and virtual reality services”   | Extended reality<br>3D   |
| Kim (2021, p. 142)                   | “An interoperated persistent network of shared virtual environments where people can interact synchronously with other agents and objects through their avatars”  | Virtual environments<br>Avatar<br>Digital objects                        |
| Lee <i>et al.</i> (2021, p. 3)       | “Perpetual, shared, concurrent, and 3D virtual spaces concatenating into a perceived virtual universe... The advent of AR and VR, high-speed networks and edge computing, artificial intelligence, and hyper ledgers (or blockchain) serve as the building blocks of the metaverse”   | Extended reality<br>AI<br>Blockchain<br>3D                               |
| Narin (2021, p. 1)                   | “A virtual universe where people feel entirely mentally with engaged augmented virtual reality devices today”   | Virtual worlds   |
| Ning <i>et al.</i> (2023, p. 5)      | “A close interaction and combination of the real and virtual worlds, which requires the integration of various new technologies to create a new form of Internet application and society”   | Virtual worlds   |
| Dwivedi <i>et al.</i> (2022, p. 2)   | “The metaverse has the potential to extend the physical world using augmented and virtual reality technologies, allowing users to seamlessly interact within real and simulated environments using avatars and holograms”   | Extended reality<br>Avatar<br>Seamless interactions                      |
| Mystakidis (2022, p. 486)            | “Post-reality universe, a perpetual and persistent multiuser environment merging physical reality with digital virtuality. It is based on the convergence of technologies that enable multisensory interactions with virtual environments, digital objects and people, such as virtual reality (VR) and augmented reality (AR)” | Post-reality<br>Multiuser platforms<br>Digital objects                   |
| Park and Kim (2022, p. 133)          | “A compound word of transcendence meta and universe and refers to a three-dimensional virtual world where avatars engage in political, economic, social, and cultural activities”   | Extended reality<br>Avatar<br>3D   |
| Barrera and Shah (2023, p. 6)        | “A technology-mediated network of scalable and potentially interoperable extended reality environments merging the physical and virtual realities to provide experiences characterized by their level of immersiveness, environmental fidelity, and sociability”  | Extended reality<br>Immersiveness<br>Environment fidelity<br>Sociability |
| Wang <i>et al.</i> (2022, p. 1)      | “An evolving paradigm of the next-generation internet aims to build a fully immersive, hyper spatiotemporal, and self-sustaining virtual shared space for humans to play, work, and socialize. Driven by recent advances in emerging technologies such as extended reality, artificial intelligence, and blockchain”            | Fully immersive experiences<br>AI<br>Blockchain                          |
| Xu <i>et al.</i> (2022, p. 659)      | “An embodied version of the Internet that comprises a seamless integration of interoperable, immersive, and shared virtual ecosystems navigable by user avatars”  | Seamless integration<br>Shared virtual ecosystems                        |
| Our definition                       | “the metaverse emerges as an innovative ecosystem made up of phygital microworlds where different actors connect, collaborate, buy, and experience by exchanging and integrating a great variety of resources in the form of NFTs within immersive contexts and paths”  | Experiment innovation<br>Multiple technologies<br>Connected actors       |

**Table 1.**  
Definitions of  
metaverse

(Shen *et al.*, 2021) and shed light on their complexity and dynamics (Hollensen *et al.*, 2023). A range of opportunities arise for marketers to engage with different consumer segments depending on their immersion level and the sensory features of the virtual environment (Dwivedi *et al.*, 2023). As Park and Kim (2022) note, the metaverse is characterised mainly by its service component and social meaning: it does not simply represent a virtual replica of a real-world society. In line with this view, other scholars stress the immersive nature of a metaverse and its ability to merge physical and virtual worlds (Mele and Russo-Spena, 2024; Xu *et al.*, 2022). Recent works focus on user experience, highlighting three dimensions: immersiveness, sociability and environmental fidelity (Barrera and Shah, 2023). The latter is understood as the extent to which the metaverse environment emulates the real world physically and functionally to enhance multiple hyperconnected virtual experiences. The convergence of multiple technologies enables multisensory interactions (involving VR, digital objects and people) and creates an interconnected Web of social, networked immersive environments in persistent multi-user platforms (Mystakidis, 2022).

Herein, we build on this broader view and provide the following definition: the metaverse emerges as an innovative ecosystem made up of phygital microworlds where different actors connect, collaborate, buy and experience by exchanging and integrating a great variety of resources within immersive contexts and paths.

#### *Metaverse main features*

The metaverse deploys through several core technologies that enable a high level of immersion and interaction, including XR (VR, AR, MR), blockchain, AI, NFTs and others.

As noted, *XR technologies* vary along points in the virtuality continuum ranging from real environments to virtual environments (Flavián *et al.*, 2019; Milgram and Kishino, 1994), differing depending on the level of perceptual presence, agency and technological embodiment that they can generate, which can affect the experiences and sensory stimulation of the users (Flavián *et al.*, 2019; Rauschnabel *et al.*, 2022). Presence is the subjective experience of feeling in one place, even if physically elsewhere. It consists of the sensation of virtual objects as real physical entities (physical presence), authentic experiences of the virtual self (self-presence) and social interactions based on the recognition of others in the virtual environment (social presence) (Hennig-Thurau *et al.*, 2023). Agency refers to how individuals perceive virtual entities as representations of real people (Blascovich, 2002). A low degree of agency suggests that users believe they are interacting with automated entities; a high degree of agency indicates that users perceive their interactions as being with actual humans controlling the avatars (Swinth and Blascovich, 2001). A highly interactive XR environment fosters a strong sense of agency (Nowak, 2004). The technological embodiment has been explored in the literature through multiple approaches. According to Flavián *et al.* (2021), it occurs when the technology mediates the user's experience by integrating into his or her body; XR can engender varying levels of embodiment. Kilteni *et al.* (2012) define the sense of embodiment as a collection of sensations that arise when fully immersed in, possessing and controlling a virtual body, particularly in VR applications. Embodiment also involves considering the social and physical actions of the virtual body as if they were actions in real life (Barbot and Kaufman, 2020; Dincelli and Yayla, 2022).

*Blockchain and NFTs* are core technologies for the metaverse (Gadekallu *et al.*, 2022). The metaverse requires a lot of data from various sources that can be sensitive or personal, such as bank or credit card information for payments and biometric or gesture data for avatar creation (Cha and Im, 2022). Blockchain can facilitate the acquisition of data by providing a transparent and trustworthy mechanism for verification and validation. Storing such a large amount of data is another challenge for the metaverse. Traditional data storage systems

may lack capacity or be vulnerable to data corruption or loss. Blockchain can offer a decentralised and distributed data storage solution that can reduce the cost and risk of data storage (Lee *et al.*, 2021). It can also enable secure and efficient data sharing by using smart contracts and fostering data interoperability (Lee *et al.*, 2021), facilitating exchanges of objects and avatars (Dionisio *et al.*, 2013). In addition, this technology is the basis for NFTs and cryptocurrencies (Wang *et al.*, 2021). The former represents ownership of virtual in-game items, avatars, real estate properties and other assets and the latter takes on the role of money in the metaverse (Dwivedi *et al.*, 2022). Blockchain and NFTs facilitate the creation of decentralised marketplaces where users can trade and exchange these assets without intermediaries (Gadekallu *et al.*, 2022).

AI plays a pivotal role in the development and evolution of the metaverse. Scholars identify the main AI use cases in the metaverse: accurate avatars, digital humans, multilingual accessibility, VR and AR expansion and intuitive interfacing. By leveraging AI technology, developers can create realistic avatars resembling users, incorporating facial expressions, emotions, hairstyles and ageing effects (Mozumder *et al.*, 2022). As AI-driven 3D entities, digital humans are not simply replicas of real individuals but sophisticated chatbots promptly reacting and responding to users' actions (Thakur *et al.*, 2023). Above all, AI provides a creative and enjoyable world for XR technologies, offering immersive devices for more engaging interactions (Mystakidis, 2022; Pham *et al.*, 2022). Integrating AI with IoT immersive devices (e.g. head-mounted screens, smart glasses, finger-worn devices, bracelets), digital objects and people (Mozumder *et al.*, 2022) makes more sophisticated multisensory interactions possible.

In summary, each technology represents a brick in implementing and advancing the metaverse. However, the metaverse's complete picture requires the integration of these cognitive, digital and immersive technologies. Emerging literature does not address how the knot of AI, blockchain and NFTs, XR and other technologies could unlock the full potential of the metaverse and shape digital and virtual interactions. In this study, we offer an integrated view of metaverse features.

## Methodology

In this research, we adopted netnography, a form of participant-observational research conducted through online resources (Kozinets, 2022). A qualitative research approach is appropriate when a more in-depth description and understanding of a complex phenomenon is required. Interpretative data collection methods can also benefit emerging research areas (Eisenhardt, 1989). Specifically, we conducted immersive netnography, an innovative methodology recommended by Kozinets (2022), to investigate how companies experience the metaverse from a phenomenological perspective. We also used visual techniques to better comprehend and interpret images and videos, which are prevalent in the metaverse (Margolis and Pauwels, 2011). In summary, we applied a "metaverse ethnography" (Dwivedi *et al.*, 2023), which allows us to gather thick data and provide contextual and qualitative insights into online communities. Thick data encompasses the narratives, implications and nuances of a particular scenario and by conducting digital observations, we can capture these implicit and sometimes imperceptible data points (Fusch and Ness, 2015; Tracy, 2019).

## Data collection

Data collection occurred during an ongoing study between January 2022 and December 2022. We carried out an internet search by using specific keywords (e.g. "metaverse", "virtual world", "digital resources") to find and select information-rich case studies (Piekkari *et al.*, 2010). The goal was to generate sufficient in-depth material to clarify the studied

phenomena' patterns, concepts and groups (Gummesson, 2005). We followed Stake's (1995) assumptions that selecting cases should present the chance to optimise the insights gleaned while acknowledging time limitations and other resources. We then consulted companies' websites, their metaverse platforms and other online resources, focussing mainly on metaverse platforms (e.g. Decentraland, The Sandbox, Roblox) and marketplaces (e.g. OpeSea, Mintbase, Crypto.com NFT) to identify companies or business project launching new initiatives. We supplemented the data collected from Web contexts with information from various documents published by business magazines (i.e. Business Horizons, Harvard Business Review), reported cases (e.g. Big Four accounting reports) and other relevant materials (Bowen, 2009). We also analysed blog posts and social media content, as these platforms play a significant role in the social construction and sensemaking of various phenomena. Specifically, we used a snowball process to expand our case collection: we identified additional evidence until reaching a saturation point at which no new data emerged (Gummesson, 2005; Lincoln and Guba, 1985). We established a judgemental sample of 25 case studies dealing with heterogeneous businesses, thereby providing more robustness and value to the framework (Järvensivu and Törnroos, 2010) (Table 2).

In addition, one of the researchers actively engaged with the companies' metaverses by assuming the role of a participant in the digital space. This immersion process involved logging in as an avatar on various platforms and observing other participants' behaviours. The researcher kept detailed notes in a diary, and the research team held discussions to enhance the validity of data collection. We also collected visual data in the form of still images (e.g. pictures, graphic design illustrations, advertisements) and moving images (videos) (Balmer *et al.*, 2015). This approach allowed us to gather rich and multidimensional data, providing insightful information about the actors involved and how they use and integrate resources, enhancing our understanding of effective approaches (Glaw *et al.*, 2017). Considering that the metaverse is predominantly a visual phenomenon, we recognised the value of images and videos as crucial data for collection and analysis.

### *Data analysis*

We conducted a qualitative content analysis (Mayring, 2004) using open, axial, reflective and selective coding in a four-step process to analyse our data (Scott and Howell, 2008). We used thematic analysis during the open coding phase to elevate raw data to a conceptual level (Gummesson, 2005). Two researchers examined the materials to identify key categories and develop a framework. We then used axial coding to establish connections and group categories based on relationships to identify the main phenomenon and its patterns. Next, we expanded the coding process and applied it to the entire data set using axial coding (Scott and Howell, 2008). We created reflective coding matrices to represent the parameters and circumstances of the primary phenomenon visually. These matrices helped establish a relational hierarchy, including the core category, subcategories and their relationships (Strauss and Corbin, 1998). Descriptions and analysis of multiple themes created a solid foundation for mapping the phenomena' dynamics and enhancing the empirical study's explanatory power (Halinen and Törnroos, 2005). We constantly compared categories through an interpretive process of selective coding to understand the construction of interrelationships and further develop conditions and dimensions (Scott and Howell, 2008). The central category of analysis was the metaverse concept (Strauss and Corbin, 1998). We repeated the procedure to enhance the findings' credibility, reliability and validity, starting from different parts of the data analysis each time. We engaged in debates to reach a consensus (Gummesson, 2005). We combined data collection and synthesis with literature to provide an integrated framework close to the facts and articulated in a sufficiently

| Company                                     | Platform  | Industry                            | Content  |
|---|---|-------------------------------------|--|
| Acqua Sant'Anna                             | Decentraland  | Bottled water                       | An NFT collection to offer buyers exclusive benefits in the form of real experiences   |
| AnamXR                                      | AnamXR  | Fashion                             | Cloud-based, virtual e-commerce platform for 3D immersive shopping experiences   |
| Ariva                                       | Ariva Wonderland  | Tourism                             | Allowing users to travel to imagined or recreated destinations   |
| Designer Daniel Avakian                     | OpenSea   | Fashion                             | Improving the customer experience by offering tokenized versions of a physical product   |
| Balenciaga                                  | Afterworld: the age of tomorrow                                     | Fashion/gaming                      | A fusion of fashion and gaming inside a virtual world  |
| Benetton<br>BMW                             | Roblox<br>ix1 metaverse   | Fashion/retail<br>Manufacturing     | Innovative customer shopping experience<br>Users can visualise a virtual copy of a real car in the ix1 metaverse                 |
| Carrefour                                   | The Sandbox   | Retail                              | A virtual space (NFBEE supermarket) dedicated to an ecological initiative (bee conservation)                                     |
| Chipotle                                    | Roblox  | Food and beverage                   | Virtual restaurant where visitors can win a voucher for a real-life burrito  |
| Compagnia dei Caraibi                       | Spatial.io  | Beverage                            | Virtual space to manage exclusive events and meetings with the sales force and customers   |
| Decentral games                             | Decentraland  | Gaming                              | A free metaverse poker game (ICE Poker) where players earn tokens  |
| Domino's pizza<br>Every realm               | Decentraland<br>Decentraland, the Sandbox, axie infinity and others | Food and beverage<br>Virtual estate | Deliveries of actual pizza in the real world<br>Investments in virtual worlds to acquire, manage and develop virtual real estate |
| Gucci                                       | Roblox  | Fashion                             | Brand activation connects with consumers   |
| Heineken                                    | Decentraland  | Beverage                            | Ironic initiative is supported by a virtual beer to bring people together in one place to socialise                              |
| Hell's kitchen                              | The Sandbox   | Entertainment                       | Attempt to integrate a TV show into the metaverse  |
| Louboutin                                   | Zepeto  | Fashion                             | Immersive digital journey  |
| Naver Z/Samsung                             | Zepeto  | Entertainment                       | A virtual world where users can create their avatars to socialise and interact with each other                                   |
| Nike  | Roblox  | Fashion                             | Virtual world dedicated to sports and products   |
| Paratissima                                 | Spatial.io  | Art                                 | Exhibition in which works are integrated into the NFT format   |
| Rai cinema                                  | The Nemesis   | Entertainment                       | A new kind of cinematic experience inside a metaverse  |
| Samsung                                     | Decentraland  | Electronics                         | A Virtual space (837X) to replicate a major physical company shop  |
| Snoop Dogg's virtual residence (Snoopverse) | The Sandbox   | Virtual estate                      | A virtual place where snoop dogg's avatar can perform exclusive concerts accessible only to his fans                             |
| Travis Scott                                | Fortnite  | Music                               | New immersive mode for enjoying an online concert  |
| Warner music group                          | The Sandbox   | Music                               | Persistent and engaging social musical experiences   |

**Table 2.**  
Metaverse cases

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understandable manner for future study (Sandelowski and Barroso, 2006). Finally, we presented the framework to two experts for their input regarding potential shortcomings in identifying patterns and categories. The discussion allowed us to grasp how companies experiment with the metaverse.

## Findings

The metaverse applications analysed herein are built on a decentralised ledger, encompassing a collection of interconnected systems, each with its own rules and processes. Companies collaborate with other organisations possessing metaverse-based technological capabilities, including providers of XR, blockchain platforms and AI-based devices. These platforms facilitate connections between various communities, integrating Web3, XR, NFT and gaming components. Some popular platforms are specialised for specific activities; for example, Fortnite and Minecraft are gaming platforms with active user communities; Decentraland is a virtual world where users can trade land, estates and digital garments while creating new content; Sandbox serves as a gaming ecosystem, empowering users to create, share and monetise in-world assets and gaming experiences; Roblox allows users to explore immersive 3D experiences, enabling imagination, creation and social interactions with friends; and Bloktopia stands out as a virtual skyscraper, offering real estate ownership and advertising opportunities to users, along with games, networking features and more.

Companies experimented with the metaverse's innovative potential in a phygital ecosystem, connecting multiple actors to collaborate, purchase and experience (Dionisio *et al.*, 2013). Some of these experiments are presented as proto-metaverses with features or the potential for a full-fledged metaverse, allowing users to create, explore and interact uniquely (Xu *et al.*, 2022). In examining how companies experiment in the metaverse, we identify four main building blocks that characterise the metaverse opportunities and overcome challenges for innovation: enabling virtual agencies, developing NFTs, designing immersive paths and crafting phygital microworlds. Each of these aspects plays a crucial role in shaping the evolving landscape of the metaverse in terms of new actors, resources, processes and ecosystems. Companies obtain learning outcomes from such experimentation and identify learning challenges, as explained in the following sections (Table 3).

### *Enabling virtual agencies*

The virtual identity is the metaverse footprint. Entering a metaverse requires users to choose an avatar – that is, to cast an image that represents and makes them, along with other data, visible to other interlocutors. All users can choose their digital appearance and behavioural traits. A 3D avatar is a virtual representation of a physical identity in a digital environment; it captures how people present themselves visually and audibly. In other words, avatars are not only simply relational but also agentive. The difference between these two types lies in their function. Whereas the former has a pure recognition task (the image merely serves to attribute specific messages to someone), the latter allows a person to act within the digital world and communicate and express intentions. As a digital version of themselves, users can perform everyday actions such as socialising, working, enjoying, buying products or participating in events. Companies enable customers (employees and other actors) to have a digital presence and agency and develop peer-to-peer interactions, business transactions, user-generated content and world-building. Avatars do not necessarily have humanoid forms; any shape can be pursued, from animals to abstract shapes. For example, at the Dolce and Gabbana presentation at the first-ever Metaverse fashion week (MVFV), guests materialised as if in teleportation from a circle of light, standing with their avatars on curved tiers around the

| Building blocks               | Experimentation outcomes   | Experimentation challenges  |
|-------------------------------|--|---|
| Enabling virtual agencies     | Hedonic and functional benefits to users<br>Gamified experiences<br>Community involvement<br>Cryptographic root of trust   | Technical issues (e.g. glitches, expression)<br>Quality and costs of devices<br>Multiple avatars  |
| Developing NFTs               | New resources<br>Expansion of the way consumers experience the brand<br>Building brand community<br>Verifiable digital property system<br>Opportunities to store details about a product's ownership, legitimacy and history<br>Tokenisation of digital reality  | From technical jargon to a common language<br>Consistency of product portfolio strategy<br>Portability and compatibility<br>Lack of regulation<br>Difficulty in defining the rules of ownership and distribution<br>Cybersecurity |
| Designing immersive paths     | New visual and sensory experiences<br>Ability to overcome barriers (e.g. geographical, physical and emotional)<br>Greater sense of engagement<br>Ability to enable customers to experiment with new activities<br>Phygital customer journey<br>Actor journey<br>How to leverage users' interactions and engagement | Lack of imagination and poor technical skills<br>Effectiveness of immersive devices<br>Understanding of how to enable customers to become creators.<br>Interoperability between different metaverses' immersive paths             |
| Crafting phygital microworlds | Sophisticated forms of user engagement and storytelling<br>Emergence of a cross between physical reality and digital connection<br>New avenues for communication and sales<br>Ability to overcome physical or geographical restrictions  | Cooperation with competent partners<br>Tech literacy<br>Low penetration of immersive devices<br>Infrastructure barriers<br>Technology readiness<br>Interoperability   |

**Table 3.**  
Experimentation  
outcomes and  
challenges

catwalk in the shape of the infinity symbol. The models were feline-faced humanoid avatars, wild fashion cats for a unique catwalk.

Several firms are already seizing the opportunity to introduce virtual apparel to capitalise on their customers' growing desire to build digital identities. Customers recognise the distinct value of fashion in these digital environments in terms of originality. For example, in "Vans World" on Roblox, users can skateboard and dress their avatars in Vans apparel and Forever 21 opened a store on Roblox and offered the possibility of "twinning" with the avatar – buying the same clothes and accessories for the real-world self. The result was a best-selling, virtual-only item, a black beanie hat, which went to the company's physical store.

This experimentation with digital identities means firms can learn how to provide users with new hedonic and functional benefits. They offer gamified experiences by enabling the activity of avatar shaping in which actors can craft and play with avatars. For example, Gucci uses Roblox's recently introduced layered clothing technology, which enables the creation of hyper-realistic 3D garments that fit avatars of any look, offering users endless possibilities for self-expression through unique combinations and looks. Similarly, in 2022, Zara offered a phygital collection of limited-edition garments for both metaverse avatars and reality. LiveGlam includes garments, accessories and makeup and is completed with three digital objects inspired by the brand's world: a brand-tagged wall, a floor and a photo booth created to enhance the digital experience.

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Companies also leverage a community of actors to generate trust to advance the project and keep community involvement high. Virtual actors interact, use and exchange resources. Digital identity poses a cryptographic root of trust that is not based on traditional human relationships. For example, Fortnite players can build their avatars, go on adventures and interact with other members of the Fortnite community. Cross-play allows users to access the game on multiple platforms, including Xbox, PCs, PlayStation and mobile phones.

### *Developing non-fungible tokens*

NFTs are new resources or assets purchased, sold and traded in the metaverse. They are considered the founding element of the metaverse because they enable an actual marketplace of digital assets (e.g. images, videos, songs and tweets) within a virtual world where the rules of ownership and distribution are difficult to define.

NFTs have created a verifiable digital property system, introducing new types of transactions. Companies experiment with NFTs as an evolution of the physical ownership of a given asset. These digital assets allow those who use them to be the valid and sole owners; the assets can be traded in the metaverse, thus creating a digital reality tokenisation process. NFTs can be used in several markets. For example, in the art market, the Liquida Photofestival is an event by Paratissima focusing on the world of photography and imaging. In the show, works are integrated into the NFT format and can be purchased by the public on the OpenSea marketplace.

Brand projects are characterised by translating actual products into the metaverse. Companies expand how consumers experience the brand, creating unique experiences for consumers to increase their level of engagement. For example, Decentraland's MVFW in March 2022 received far more industry attention than any previous digital fashion event, attracting various brands and creatives. The experience was blockchain-based, with digital fashion bought and worn as NFTs. Thus, these tokens become the digital touchpoints between brands and consumers, providing novel brand enjoyment. As another example, Adidas launched a collection called "Into the Metaverse", which consisted of real clothes and the firm's digital version, developed by Bored Ape Yacht Club and Punks Comics. All NFTs made available by Adidas in the primary market were purchased within minutes of being issued. Each NFT Bored Ape also grants access to an exclusive club, offering owners a range of benefits: limited-edition products, the chance to participate in exclusive events and more. NFTs enable a direct connection between a brand and its fan base, eliminating physical product issues (e.g. shipping problems, product defects, storage costs). New concrete opportunities for new branding arise, thus increasing profits. There are numerous examples in this context. Nike recently released Nike Cryptokicks, a virtual version of its Nike Dunk sneakers; Louis Vuitton released a video game with collectable NFTs that Bleep essentially created; Balenciaga dropped a line of virtual gear and apparel in Fortnite with a physical collection; and Gucci sold a virtual version of its Dionysus bag for the equivalent of \$6 on Roblox.

NFT digital twins can also store details about a product's ownership, legitimacy and history, which is useful for luxury stores fighting counterfeiting attempts. Regarding its new Tonale model, vehicle manufacturer Alfa Romeo does not intend to generate profit margins from selling NFTs on marketplaces. Instead, the carmaker aims to use blockchain-based technology to track the life cycle by equipping each vehicle with a personalised, identifying, unique NFT. This technology would benefit the future of an Alfa Romeo Tonale should the owner wish to resell it, guaranteeing trusted and reliable information about the car's past life to any potential purchaser.

Because NFTs can be used in physical and digital environments, they may become digital keys to online places, tickets or membership cards that grant entry to digital or actual events. For example, Acqua Sant'Anna created an NFT collection that offers buyers exclusive benefits through authentic experiences. Heineken launched its Silver Beer on Decentraland by creating a brewery dedicated to virtual tastings. This ironic initiative aims to bring people together in one place to socialise. Similarly, the arrival of the popular TV show "Hell's Kitchen" on the Sandbox platform allowed users to create virtual dishes (as NFTs) and participate in culinary competitions.

Owning an NFT entails more than just essential possessions; it also gives creators a vital tool for building a brand's community. To grow the ecosystem, NFT designers frequently arrange matches between NFT owners or sometimes give NFT owners more tokens. In doing so, the owner of a particular NFT simultaneously becomes an investor, a member of a club, a shareholder and a participant in an effective loyalty programme. In the Sandbox and other platforms, users can also control and profit from their in-game experiences thanks to NFTs by purchasing and selling land and other assets.

### *Designing immersive paths*

Multisensory interactive environments allow for an immersive experience – an innovative way of enjoying content in virtual or augmented paths with which users can fully interact. Companies design immersive paths, often using VR or AR technology and captivating devices, to learn how to leverage users' interactions and engagement through various platforms. These paths involve a variety of senses to make the user feel present in a setting that is either enhanced or distinct from the one they are engaged. For example, Moncler Genius unveiled its new collection with the Mondogenius event: an immersive digital experience that, for the first time, connected viewers worldwide in a single event, taking them to five cities across Europe, Asia and the USA to narrate the vision of the 11 Genius designers. Accompanied by singer Alicia Keys, the audience journeyed between the physical and the digital to discover the inspirations and aesthetics of each collaboration, explored through art and multidisciplinary performances.

The 3D-rendered formats possible in a metaverse far better serve online representations of tangible goods. Instead of seeing a product as a flat image on a screen, clients may see it in motion as it is depicted in a 3D world with which they can physically interact. A virtual path is, first and foremost, a moment of encounter and exchange that can overcome all kinds of barriers, be they geographic, physical or emotional. Social VR applications allow actors to share a virtual space with other real or virtual users, identified by a 3D avatar. Customers can visit the digital twin of physical stores from anywhere and have a boutique experience, while staff members can collaborate across the metaverse. For example, Louboutin, in collaboration with the Korean game app Zepeto, created a virtual "Loubi World" where VIPs and journalists could view its spring–summer 2021 collection while exploring Paris landmarks and interacting with a digital doppelganger of Christian Louboutin.

In the context of VR, immersion transforms metaverse digital engagement from simply consumption to active creation. The sense of engagement generated in the immersive experience is more effective as we can connect better with the context through sensory perception. This multisensory involvement provides an authentic experience that companies can build on further. Nikeland has a provocative slogan – "the sport has no rules" – touted in a video where 3D characters appear, resembling LEGO products in their plastic poses. Everyone at Nikeland is wearing Nike tracksuits, shoes and caps. The company launches prototypes of shoes, and users try them on in the virtual world before mass production starts – a kind of laboratory in which users' interests can be analysed.

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By creating emotional contexts, companies use new technologies to stimulate involvement and invite consumers to experiment with new activities, test their abilities and learn. In the tourism sector, new technologies encourage participation and invite visitors to learn and, therefore, to visit physically. Similarly, by mixing education and gaming, companies can design new learning contexts that are highly interactive and immersive. Minecraft has launched an educational version of the game in which the structure is based on crafting and farming, and ample space is left for the player's creativity in developing the game world. During sessions, entire digital worlds can be built and actual objects can be printed in 3D. Users can create digital landscapes, settings from the past, constructions, molecular structures or simple geometric shapes within cooperative environments in which they create and solve problems together.

### *Crafting phygital microworlds*

A metaverse includes new phygital microworlds with multiple interacting actors who exchange and integrate resources. Firms craft their habitats on a new ecosystem so that users can do more than look for products on a website. Often, applications and methodologies enabled by the metaverse are implemented in-store. Thus, digital users and site visitors can naturally interact with businesses' custom new spaces, creating the potential for both. For example, Benetton Group has created the same emotional ecosystem in physical retail as in the new virtual store in the metaverse, such that anyone entering the shop in Milan can immerse themselves in a cross between physical reality and digital connection in an explosion of creativity, colours and sounds.

From an advertising and sales standpoint, the metaverse provides a new way to connect companies' virtual and physical spaces, creating new avenues for advertising and sales. Physical venues have digital counterparts in virtual worlds, as in the case of cultural events or cultural organisations that can exist both in the physical world and on digital displays or music concerts held in both a concert venue and a virtual bar. Another example is the Chipotle platform, which established a virtual restaurant in Roblox for a Halloween campaign and gave a voucher for a real-life burrito to any visitor wearing a costume. Furthermore, Domino's will start offering pizza orders within Decentraland: users can order virtually and receive a physical meal delivered to their doorsteps. In addition, BMW has brought its BMW iX1 into the iX1 metaverse, where visitors can view a virtual version of a real car, take selfies with their avatars or obtain an exclusive BMW sweatshirt.

Users encounter no physical or geographic restrictions regarding who can attend a virtual event, regardless of location, abilities or financial situation. Both physical-to-virtual and virtual-to-physical interactions shape new phygital words, as in the case of the Festival Dei Due Mondi di Spoleto, which presents *Le Bal de Paris de Blanca Li*, where real and virtual coexist in a metaverse – at once retro, futuristic, classic, contemporary. With optical visors and movement sensors, users can watch the scenic action and be the protagonists, dancing and interacting with the live dancers and robots.

### **Discussion**

The metaverse emerges as a dynamic phygital ecosystem where virtual and physical actors interact through social media, gaming, XR and cryptocurrencies, creating immersive and real-time interactive experiences (Smart *et al.*, 2007). Our main contribution herein is to address the metaverse as a new experimentation field. Companies must navigate the initial phase of the proto-metaverse, a stage of exploration at which they experiment with engaging customers and driving innovation in novel ways (Xu *et al.*, 2022). In this initial