Please quote as: Lowry, P. B., Boh, W. F., Petter, S. & Leimeister, J. M. (2025). Long Live the Metaverse: Identifying the Potential for Market Disruption and Future Research. Journal of Management Information Systems (JMIS), 42, 3-38. doi: 10.1080/07421222.2025.2455770

Journal of Management Information Systems

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/mmis20

Long Live the Metaverse: Identifying the Potential for Market Disruption and Future Research

Paul Benjamin Lowry, Wai Fong Boh, Stacie Petter, Jan Marco Leimeister & Guest Editors

JOURNAL OF MANAGEMENT INFORMATION SYSTEMS
2025, VOL. 42, NO. 1, 3–38
https://doi.org/10.1080/07421222.2025.2455770

GUEST EDITORIAL

Long Live the Metaverse: Identifying the Potential for Market Disruption and Future Research

Paul Benjamin Lowry[a], Wai Fong Boh[b], Stacie Petter[c], and Jan Marco Leimeister[d], Guest Editors

[a]Business Information Technology, Pamplin College of Business, Virginia Tech, Blacksburg, VA, USA; [b]Information Technology & Operations Management, Nanyang Business School, Nanyang Technological University, Singapore; [c]Wake Forest University School of Business, Wake Forest University, Winston-Salem, NC, USA; [d]Institute of Information Systems and Digital Business, University of St. Gallen, St. Gallen, Switzerland

ABSTRACT

The Metaverse represents a transformative frontier, blending physical and virtual realities into immersive, persistent digital environments. This article explores the foundational components, emerging markets, and critical challenges shaping the Metaverse's evolution. Although initial industry enthusiasm has been tempered by financial setbacks and shifting priorities toward generative artificial intelligence (AI), the Metaverse remains nascent, following a familiar hype cycle with other disruptive technologies. Drawing parallels with historical technological breakthroughs, we argue that continued hardware, software, and telecommunications advancements will unlock the Metaverse's potential for profound societal and economic impact. We explore the potential for business approaches and collaborative efforts across various market sectors, including consumer goods and commercial services, as well as healthcare and industrial realms. To do so, we explain how technologies like virtual reality (VR), augmented reality (AR), and extended reality (XR) increase user participation through consuming content that creates a sense of presence while at the same time outlining Metaverse challenges, risks, technological difficulties, and sociotechnical factors. By dissecting specific use cases and proposing strategies for managing challenges like data privacy, security, and inclusivity, we chart a path for researchers and practitioners to foster innovation. The article concludes with a call to action for researchers to lead visionary efforts, urging them to anticipate and shape the future possibilities of the Metaverse beyond current technological and market constraints. By breaking down the Metaverse into targeted applications, this work provides a roadmap for advancing theory, design, and practice to unlock the Metaverse's full disruptive potential. We challenge the notion that the Metaverse is "dead," instead framing it as an enduring societal and economic transformation catalyst.

KEYWORDS
Metaverse; consumer metaverse; commercial metaverse; industrial metaverse; healthcare metaverse; virtual reality; mixed reality; augmented reality; extended reality; artificial intelligence; immersive systems

Introduction

In the early 2020s, many organizations were excited about the promise of the increasing capabilities of technologies, such as virtual reality (VR) and augmented reality (AR), to allow individuals to work and play within what was envisioned as "the Metaverse."

CONTACT Paul Benjamin Lowry Paul.Lowry.PhD@gmail.com Business Information Technology, Pamplin College of Business, Virginia Tech, Pamplin Hall, Suite 1007, 880 West Campus Drive, Blacksburg, VA 24061, USA

This article has been corrected with minor changes. These changes do not impact the academic content of the article.
Supplemental data for this article can be accessed online at https://doi.org/10.1080/07421222.2025.2455770

Although the definition of the Metaverse is evolving and wide-ranging based on each stakeholder's perspective and goals [26], one broad definition is a persistent, virtual representation of a world and its users accessed using technology. Although often referred to as *the* Metaverse, there is no singular Metaverse that individuals may access or experience. Instead, many metaverses exist for different purposes depending on the reason for creating the virtual world.

Organizations, groups, and individuals have recognized commercial and social opportunities within the Metaverse. Because physical and geographic boundaries are irrelevant within a Metaverse, the constraints of the physical world can be reimagined. Individuals can interact in similar or different ways than the physical world. Recognizing the potential of the Metaverse, many of the world's leading technology companies invested tens of billions of dollars on related software and hardware to foster this market, including Meta (famously renamed from "Facebook" as an all-in bet on the Metaverse), Microsoft, Snapchat, Amazon, NVIDIA, Epic Games, Apple, among others [52]. Others are considering how Metaverse applications can improve an individual's quality of life [66] or positively influence society [74].

A few years after Facebook renamed itself to Meta, the division focusing on the hardware and software to power its Metaverse has billions of dollars in losses each quarter, with more than $45 billion in losses between 2020 and 2024.[1] The progress and momentum around the Metaverse that developed in the early 2020s appears to have stalled, mainly as firms now focus more on generative artificial intelligence (GenAI). The most ardent critics have questioned if the Metaverse is "dead" or mere marketing hype.

Rather than suggesting that the Metaverse is dead or stalled, we contend that the Metaverse is still in its nascent stages [42], as it continues to move through the usual hype cycle seen with breakthrough technologies. As hardware, software, and telecommunication advancements persist, the Metaverse will unleash a new wave of disruption. As information systems (IS) scholars, we should recognize the hype cycles inherent in any significant technological breakthroughs. We saw similar cycles with mainframes, minicomputers, personal computers (PCs), the Internet, and smartphones. Most recently, we observed this cycle with AI, which went through various phases to achieve its current disruptive state with GenAI. Many advances within GenAI will likely be fundamental enablers for many Metaverse applications.

What factors are at play in the Metaverse that, once addressed, will lead to a convergence toward disruptive breakthroughs? First, we need economies of scale and scope, especially concerning specialized hardware. Hardware and software that promotes immersive experiences in the Metaverse, such as VR and AR headsets and glasses, have made tremendous progress, but many are too expensive for mass adoption. Second, there must be highly profitable breakthrough markets and innovative business models where network effects and lock-in are possible on a large scale. The early dot-com bubble burst of 2000-2002 was due to massive investments and considerable increases in stock prices in conjunction with little profitability, as most business models were rehashed mainly from brick-and-mortar models. Although Amazon.com is a success story of the dot-com era, its original business plan did not offer much regarding a business model revolution. As Amazon scaled the volume and breadth of its offerings to achieve greater network economies of scale and scope, it also created a sophisticated technological infrastructure that it used for its core offering. Amazon has leveraged the primary infrastructure used for its original business model to innovate and diversify itself with Amazon Web Services (AWS), third-party fulfillment services, and Amazon Prime.

Likewise, the same pattern must be followed in creating Metaverse-specific business models, marketing strategies, and products [75]. Assuming that the physical hardware and network infrastructure will soon provide what is needed to make the Metaverse successful, information systems scholars should engage in research to consider new business models and designs to support the Metaverse and its applications. As an immersive and complex structure, the Metaverse imposes considerably greater demands than previous online businesses or platforms [37, 65, 93, 98] and requires more advanced technological ecosystem approaches [3]. Fostered by the virtually endless use cases in the Metaverse, organizations struggle to manage the increasing complexity and fail to capture this emerging technology's broader business model and market potential [11]. Although these demands may cause short-term profiteers to pause, such demands should be considered exciting research problems for scientists to address. Likewise, the extensive array of business prospects in the Metaverse calls for entirely new combinations of online and offline business theories to generate sustainable profit streams [69].

As we emphasize in this article and throughout the corresponding special issue on the Metaverse, we encourage researchers to break down the Metaverse as a monolithic black-box idea into more specific markets, business models, and opportunities. We can provide discourse-specific theories, design artifacts, affordances, processes, methods, and empirical evidence to foster breakthrough innovations at these more meaningful levels. Thus, in this article, we first describe some of the foundational technological components of the Metaverse. Next, we identify some major markets, business models, and opportunities for the Metaverse. Of these, researchers in the sciences of the artificial should contribute by projecting ahead of these trends, not reacting to them. Some of these markets and models are more mature than others, and more advanced industrial and healthcare breakthroughs in the Metaverse will be built on the foundation of the consumer and commercial Metaverse. Understanding and focusing on specific contexts within these discourses will be crucial to making meaningful scientific contributions. Finally, we review each article in the accompanying special issue on the Metaverse and offer additional suggestions for future research to expand understanding and opportunities.

Foundational Components and Enablers of the Metaverse

Although credit for the term "Metaverse" is generally attributed [54] to Neal Stephenson's 1992 novel, *Snow Crash*,[2] conceptualizations of the Metaverse appeared in science-fiction works several decades before. Several metaverses appeared in the 2000s and rose in popularity over time, often experienced through games (e.g., World of Warcraft, Fortnite) or sandbox worlds (e.g., Second Life, Minecraft, Roblox). Hardware, software, and telecommunication advances enable more individuals to access and participate in the Metaverse. There will likely be applications where users can use the Metaverse without AR or VR technology, but these technologies typically foster more engaging experiences.

IS scholars have studied virtual worlds for decades [e.g., 21, 49], and virtual worlds are foundational to the Metaverse. Although a given Metaverse typically involves a virtual world, not every virtual world is a metaverse. Nevertheless, a Metaverse evolves as users interact with the virtual world and one another and persists regardless of whether users are present [33]. Users have virtual depictions within the Metaverse in the form of avatars, which may range from realistic to deceptive representations of the user [22]. Much early IS research on virtual worlds focused on the open sandbox Metaverse, Second Life [e.g., 22]. Massively multiplayer online games (MMOGs) can also be metaverses and have long been topics of study within the IS discipline [e.g., 71, 85]. Existing research on virtual worlds can influence our understanding of the Metaverse. For instance, having a strong sense of ownership in a virtual realm can lead to spending more time there and actively participating in activities, which increases the likelihood of returning to the world later [49]. When individuals are gifting in virtual worlds, they experience a higher formation of social connections and social engagement, ultimately impacting future system use and purchasing intentions [35]. Consequently, researchers should not assume they must start researching the Metaverse from scratch. The extant research and knowledge in virtual worlds and virtual interactions (with many of these studies increasingly examining metaverses) is a great place to start to guide or inform further study.

The Metaverse goes beyond mere virtual worlds, and thus, it will continue to evolve in its functionality, purpose, and ability to reach new audiences based on a series of enabling technologies. Many of these changes are emerging because of increased hardware, software, and telecommunications capabilities to create extended modes of reality. Based on our literature review, we propose a taxonomy of three tiers of enabling technologies of the emergent Metaverse, detailed in Figure 1. We review these tiers as follows.

Tier 1: Communication and Infrastructure Technologies of the Metaverse

Communication and infrastructure technologies are critical foundational elements of the Metaverse and include cloud computing, edge computing, 5G/6G wireless, and other advanced networks. The various forms of cloud computing (e.g., public, private, hybrid, community) will combine with multiple service models and edge computing [14] for several types of Internet of Things (IoT), AI/machine learning (ML), content delivery, industrial, retail, healthcare, smart city, and automotive edge computing [96]. Creating higher fidelity environments that offer more realism and interaction among other users requires high bandwidth and immense computation power through edge and cloud computing. As wireless technology evolves through 5G and 6G—including terahertz band communication, AI-driven wireless, and even quantum communication—individuals can experience the Metaverse using extended reality (XR) technologies without being tethered to a computer or console through a wired connection [81]. As individuals leveraging XR and the Metaverse can experience the same levels of bandwidth for wireless connections as hardwired connections, it changes where people must be physically located to experience the Metaverse. These will further evolve with Web 3.0, likely including quantum networks, space-based communication, and blockchain-enabled networks. Advanced networking technologies supported by the changing capabilities provided by hardware, software, and telecommunications technologies will allow for extended modes of reality.

Tier 2: Foundational Technology Enablers of the Metaverse

Building on the possibilities that the foundational communication and infrastructure tier foster, we have grouped the next tier of Metaverse technology enablers into four main categories:

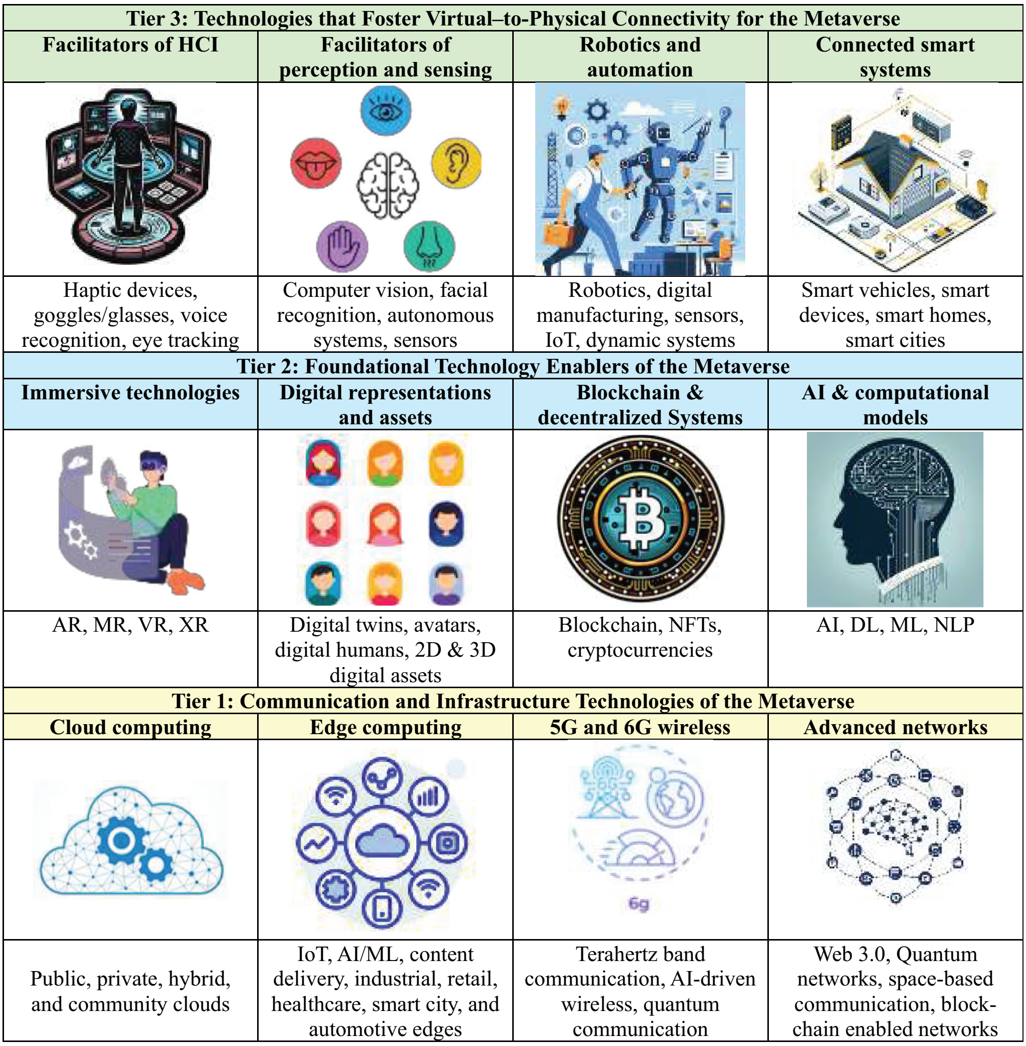

Figure 1. Taxonomy of three tiers of enabling technologies for the emergent metaverse. Abbreviations: HCI, human-computer interaction; AR, augmented reality; MR, mixed reality; VR, virtual reality; XR, extended reality; NFTs, non-fungible tokens; DL, deep learning; ML, machine learning; NLP, natural language processing; IoT, Internet of Things; AI, artificial intelligence.

(1) **Immersive technologies**: What makes these technologies essential in the context of the Metaverse is the ability to provide different types of immersive experiences for users that can lead to new and other business and research opportunities. XR includes various forms of multimodal virtual-to-physical realism—the blending of virtual and physical worlds—and typically leverages VR, AR, and mixed reality (MR) [89]. VR immerses the individual in a virtual world (and limits their experiences in the physical world), often using a headset and motion-sensing trackers [25, 73, 79]. AR allows users to still engage with the physical world but overlays animations, text, or other visuals to support one's engagement in the physical world using headsets or glasses [10, 79]. MR combines AR and VR in which the virtual elements interact with physical objects in the real world [15, 89].

(2) **Digital representations and assets**: These technologies include *digital twins* (virtual reproductions of systems or physical entities [56]; *avatars* (digital representations of users or entities in virtual spaces) [6, 22]; *digital humans* (realistic digital representations or simulations of humans); and *2D and 3D digital assets* (graphic or virtual items created in two or three dimensions for digital use) [61].

(3) Blockchain and decentralized Systems: This technology category includes blockchain, non-fungible tokens (NFTs), and cryptocurrency. *Blockchain*, which is an emerging distributed ledger technology that underpins NFTs, cryptocurrencies, and other decentralized systems [39, 80]. NFTs, which are unique digital items recorded on a blockchain [80]. Finally, *cryptocurrencies* are digital currencies secured through blockchain technology.

(4) **AI and computational models**: The computational models that are generated here involve various AI technologies, including ML, deep learning (DL), and natural language processing (NLP). ML is an AI subset that focuses on algorithms that learn from data. DL is a subset of ML leveraging neural networks for complex tasks. In AI, NLP is used to process and interpret human language, traditionally in text format.

Tier 3: Technologies that Foster Virtual-to-Physical Connectivity for the Metaverse

Finally, exciting new research and market opportunities await as the foundational elements of virtual worlds, XR hardware and software, and communication technologies continue to evolve and converge within the context of the Metaverse. We argue that the next step in envisioning these possibilities is to examine another final enabling tier of Metaverse facilitators that allow the blending of and connection between physical and virtual worlds and interactions, which we categorize into four groups.

(1) **Facilitators of human-computer interaction (HCI)**: These include *haptic devices*, which provide tactile feedback or simulate the sense of touch, enhancing user interaction with digital systems [25, 67]; *goggles/glasses*, which are wearable devices often used in AR, VR, or MR environments to enable immersive visual experiences; voice recognition, which is a technology enabling machines to understand and respond to spoken language, often used in virtual assistants and voice-controlled devices; and eye tracking, which is a technology that monitors and analyzes eye movement, often used in VR/AR systems, user behavior analysis, or accessibility tools. Eye tracking in goggles enhances AR/VR experiences by enabling gaze-based interactions and adaptive content display.

(2) Facilitators of perception and sensing: These include computer vision and physical world integration. *Computational vision* enables computers to analyze and make sense of data in the environment; it is commonly employed for identifying objects and faces and powering autonomous technologies. *Physical world integration* can occur when technologies are leveraged—such as sensors and systems that digitize real-world objects, the IoT, or environments for interaction or analysis—to bridge the "real" world and virtual worlds.

(3) **Automation, connectivity, and control**: This group focuses on technological enablers, platforms, and systems that underpin automation, connectivity, and dynamic control *Robotics* pertains to machines created to carry out tasks independently or with some level of autonomy and commonly leveraging technologies, such as AI and computer vision, for interaction and task completion. HCI and robotics can integrate such that haptic devices and voice recognition enhance human-robot interaction for teleoperation or personal assistance. Robotics often integrates sensors to understand and interact with the

physical world, creating dynamic and adaptable systems. Automation typically involves digital manufacturing and using robotics, sensors, and IoT in an automated smart process with dynamic systems.

(4) **Connected smart systems**: This group emphasizes smart end-user applications and solutions. Here, we are dealing with a world of connection possibilities that started with IoT but has emerged to include connected smart vehicles, smart devices, smart homes, and smart cities. Smart connected cars are equipped with sensors and communication technologies alongside AI capabilities to support autonomous driving and facilitate vehicle-to-everything communication and intelligent navigation systems [18]. A variety of *smart devices* include items like smartphones and smart TVs, along with speakers that voice commands can control. A *smart household* incorporates internet-connected devices and systems designed to oversee, automate, and regulate domestic tasks for improved comfort, convenience, efficiency, and security [72]. *Smart cities* use IoT, ML, and AI technologies to facilitate remote management and smart decision-making processes. A modern city incorporates cutting-edge information and communication technologies, devices, and AI tools to improve urban service quality and efficiency in using resources while enhancing residents' living standards overall [13].

Emerging Metaverse Markets: Opportunities and Challenges

To this point, if we focus merely on the technologies and enablers of the Metaverse, it simply offers a world of possibilities that are essentially a "black box." To open the box and succeed in the emerging Metaverse space, organizations should not simply transfer known, existing business models to the Metaverse and expect a resounding success. Thus, researchers and practitioners should investigate and understand emerging markets and their specific challenges and opportunities. We describe four markets, two of which are mass markets—consumer and commercial metaverses—and two of which are expert-driven niche markets—industrial and healthcare. In doing so, we share our thoughts on the opportunities and challenges that can drive the potential for new business models and innovative research in leveraging online platforms and ecosystems such as digital manufacturing, online gaming, online shopping, digital commerce, virtual worlds, online entertainment, social media, and virtual payments and economy. To help envision the opportunities in Table 1 we create a three-dimensional typology of the four major metaverse markets in which we depict the general purpose (efficiency vs. experience), the general business model (business-to-business [B2B] vs. business-to-consumer [B2C]), and the market focus (niche or mass). In short, the *Industrial Metaverse* generally supports manufacturing and logistics in many complex and specialized segments. Thus, it represents (a) B2B, (b) efficiency, and (c) niche markets. The *Commercial Metaverse* market enables transactions to exchange goods, services, or currency among individuals or organizations, but to differentiate it from mere e-commerce, the key focus here is on the experience itself and customer engagement. Thus, it represents (a) B2B, (b) experience, and (c) mass markets. The *Consumer Metaverse* is developed for individuals and is typically designed to provide entertainment or hedonic experiences for users. Thus, it represents (a) B2C, (b) experience, and (c) mass markets. Finally, the *Healthcare Metaverse* is emerging to support highly specialized clinical and patient concerns and to help improve outcomes cost-effectively. Thus, it represents (a) B2C, (b) efficiency, and (c) niche markets.

Table 1. 3D typology of the four major metaverse markets: Purpose × business model × market focus.

		dimension 2: general metaverse purpose	
		Efficiency	Experience
Dimension 1: Metaverse Business Model	Business-to-business (B2B)	**Industrial** **Dimension 1 = B2B** **Dimension 2 = efficiency** **Dimension 3 = niche markets** e.g., digital twins, predictive maintenance, supply chain optimization, and training simulations for manufacturing, energy, or logistics industries.	**Commercial** **Dimension 1 = B2B** **Dimension 2 = experience** **Dimension 3 = mass markets** e.g., virtual trade shows, immersive marketing for businesses, virtual shopping, business-client collaboration spaces, and corporate education.
	Business-to-consumer	**Healthcare** **Dimension 1 = B2C** **Dimension 2 = efficiency** **Dimension 3 = niche markets** e.g., medical training for professionals, telemedicine platforms, virtual diagnostics, and surgical simulations.	**Consumer** **Dimension 1 = B2C** **Dimension 2 = experience** **Dimension 3 = mass markets** e.g., gaming, virtual concerts, social spaces, consumer education, and entertainment-driven experiences for everyday users.

Notes. All dimension values are labeled in each quadrant; Dimension 1 (bottom row in green): B2B vs. B2C; Dimension 2 (top row in red): general purpose: efficiency vs. experience; Dimension 3: The lighter-shaded colors (left column) represent niche markets, whereas darker-shaded colors (right column) represent mass markets.

Mass Market: Consumer Metaverse

The initial and continuing driver for many Metaverse developments is the consumer Metaverse, with gaming and e-sports, social media, and other forms of entertainment leading the way to provide hedonic experiences for users. As more individuals adopt and engage in these consumer-oriented metaverses, other Metaverse applications will have a much easier path to extended adoption.

The consumer Metaverse is fueled by the Metaverse-powered specific elements of digital mediation, spatiality, immersion [38], and social elements such as telepresence and co-presence. Digital mediation suggests that consumers use technology as a channel and tool. Consumers are using available platforms to interact with other users while also working with the technology to interact with digitally created content [38]. Spatiality involves users interacting in three-dimensional "virtual worlds" in much the same way as in video games while exhibiting properties like physical spaces, such as limiting interactions with only users or properties co-located in one's space at a given time. Immersion ensures realistic experiences for the user within a simulated environment where she experiences a feeling of presence, defined as the psychological experience of "being there" [20, 38]. This is enhanced through visual and auditory sensations, tactile feedback, and smells enabled by haptic and olfactory devices. Immersion, along with the

3D spatiality, also offers additional affordances to users that support identity construction in the form of a digital representation of the self or a persona called an avatar. Avatars enable free self-expression and encourage distinct user behaviors, resulting in unique experiences within the Metaverse. Telepresence gives users the illusion of freedom that disregards the technological medium through which they communicate [27] while engaging with the Metaverse. In the Metaverse, telepresence is further extended through interactions with other user personas, which provides co-presence or a feeling of being together with people who matter [48].

Consumer Metaverse Emerging Market Segments

One major consumer Metaverse market segment is gaming. A recent Ernst & Young report forecasts the global Metaverse market to reach $280 billion globally and gaming at an estimated $211 billion by 2025.[3] Metaverse capabilities and global 5G rollout will boost the gaming segment and challenge extant business models. Gaming has pioneered virtual worlds, where immersive, simulated environments are utilized for gameplay. The technological capabilities of Metaverse have the power to transform the "microverses" or virtual worlds used in classic massively multiplayer online role-playing games (MMORPG) such as World of Warcraft into metaverses [30], facilitating a coalescing of the various virtual gaming worlds. This further expands their reach, scope, and potential for commercialization. Ernst & Young also suggest that the gaming industry will continue to play a prominent role in developing the Metaverse, indicating how gaming elements could integrate into other Metaverse consumer applications, including social media, events, and education.

Social media platforms in the Metaverse are expected to transform, reshaping how people perceive and use these mediums for socializing. They are expected to offer more immersive and interactive experiences beyond traditional formats.[4] For example, virtual socializing could evolve from text messages, nudges, or video calls to meeting a distant friend in a virtual café or mall or even taking a stroll together in a park, side-by-side.

Live entertainment and events can reach mass audiences within the Metaverse. Consumers can leverage VR and AR to participate in immersive virtual social experiences within the Metaverse [55], such as watching and participating in live events, such as theatre performances, concerts, and virtual real-time interactions with famous artists and pop stars. Users can attend any global event instantly from the comfort of their homes and enjoy unique experiences [7]. Artists can also connect with international fans, enabling them to generate new revenue streams by selling tickets and merchandise. Corporations can host corporate events to offer customers engaging experiences in Metaverse. For example, Ralph Lauren organized a "Winter Escape" Roblox event in December 2021. Consumers engaged in making hot chocolate, ice skating, marshmallow roasting, and tree decoration[5] [86]. Finally, the Metaverse is starting to play a unique role in the adult entertainment industry by leveraging various immersive and unique haptic technologies to create more engaging and realistic consumer experiences. [6]

Consumer Metaverse Limitations and Challenges

The current state of development in the consumer Metaverse faces various challenges and limitations, encompassing both technological and socio-psychological factors. These issues represent some of the more compelling research opportunities for Metaverse research. First, the quality of immersion that underpins the Metaverse experience relies on ultra-high-speed transmissions and exceptionally low latency, surpassing the capabilities of conventional networks and Bluetooth technology. Currently, the robustness of the underlying data communication platform [4] cannot support the transmission speeds and latency requirements. Ubiquitous and accurate real-time sensing is critical for many Metaverse applications, and a 6G network is essential to support this requirement [81].

Challenges with interactions within consumer metaverses limit its applications and appeal to users. Multimodal interaction is central to the promised user experience, and virtual world interaction distinctly differs from the conventional virtual world. Haptics and olfactory devices that provide such interactions and experiences are currently in the early stages of development. Haptic feedback, such as those enabled by a ring equipped with temperature sensing and vibratory and thermal feedback, enhances the user's sensory experience. Much of the growth in this area depends on the pace of mechatronics innovation and advancements in psychophysics, which studies the links between stimuli and perception. However, these areas are still evolving [67]. Likewise, olfaction or smell is an important aspect that enhances user experience as humans identify with everyday scents emanating from various real-life scenarios that trigger memories. Yet, the current development of olfactory feedback technologies has limitations, including bulky physical dimensions, limited scent-sensing capability, and slow response times [99].

To embrace Metaverse applications, users must be carefully designed for user readiness, engagement, interest, affordability, security, and privacy concerns [5, 42]. However, addressing such design requirements is a tall order and requires highly skilled developers who are not in ready supply [58]. Data privacy and security concerns necessitate advancements in existing security systems to meet the unique requirements of the Metaverse. For example, identity authentication must extend beyond human users to encompass all artifacts, services, and their interactions within the Metaverse, presenting challenges due to the vast volume of exchanges. More rigorous data protection measures will be needed because the information exchanged in the Metaverse includes data from all five human senses [81]. Because abuses occurring in the physical world can also manifest in the Metaverse—including hate crimes, doxing, stalking, and extortion [34]— users need to perceive personal security when interacting. Some fear sexual harassment within the Metaverse and have altered their behaviors and interactions accordingly [68]. Some companies have developed creative solutions, such as protective bubbles, to prevent other avatars from entering one's personal space and to create a greater sense of individual and emotional safety for users[7]. However, more must be done to enhance users' sense of safety, trust, and privacy when engaging with the Metaverse.

Consumer Metaverse Use Cases

The primary target audience of the Metaverse is Gen Z, a generation of digital natives who have grown up with technology [51] and are already engaging with early forms of the Metaverse, such as virtual worlds and social gaming platforms. Their familiarity with digital environments and comfort in navigating and personalizing virtual spaces positions them as key influencers in how the Metaverse will evolve. Because Gen Z represents an influential group of early technology adopters, their preferences, behaviors, and expectations will likely play an outsized role in shaping the evolving design, features, and products of the Metaverse.[8]

The Metaverse enables immersive 3D storytelling by allowing users to engage within dynamic, interactive environments where they become part of the narrative rather than mere observers. In these 3D environments or settings, people can immerse themselves in intricately designed settings, engage with virtual items and personalities, and influence the storyline through their choices, resulting in a highly individualized and captivating journey. Such storytelling has a range of use cases across industries and beyond the consumer Metaverse. In education, storytelling in the Metaverse can bring historical events or scientific concepts to life, allowing students to "experience" their lessons firsthand. In marketing, brands can create memorable stories around products, inviting customers to participate in virtual adventures. In virtual tourism, the Metaverse can make distant or exotic locations easily accessible to everyone, offering immersive travel experiences where users can explore iconic landmarks, ancient ruins, or natural wonders from their own homes.[9] 3D storytelling enhances emotional engagement and understanding, making it a versatile tool for communication and learning in the Metaverse.

Consumer Metaverse Opportunities for Business Models and Research

The convergence of gaming and entertainment has developed new business models. The traditional gaming model has gone from one-time purposes to monthly or yearly subscriptions to freemium models, the latter of which popular games in the Metaverse successfully leverage freemium models. For instance, Epic Games's own Fortnite leverages a freemium business model. Epic Games gives the game away for free and makes money by charging for virtual products within the game and engaging in collaborative marketing agreements. Fortnite has been involved in lucrative marketing collaborations with dozens of brands (e.g., Marvel, DC Comics, National Football League, Balenciaga), content creators (e.g., Netflix, Mr. Beast), and celebrities (e.g., LeBron James, Ariana Grande, Travis Scott)[10]. Another instance is Roblox, a free-to-play game that asks players to pay for items within the game and subscriptions while collaborating on advertising and promotional campaigns with top brands. This game was originally well-known and popular among the tween audience, but Roblox wanted to reach a fast-growing age demographic: 17- to 24-year-olds. As a result, Roblox announced the ability to offer exclusive experiences and content for those 17 and older, enabling new business opportunities for Roblox as they create experiences for older users[11].

Choices involving avatar use in the Metaverse can have a profound psychological impact on user behavior and thus could "bleed" into the real world with meaningful societal implications. This phenomenon, called the "Proteus effect," must be investigated to understand its effects on social behavior and the community at large [94]. Conflicting identity cues between avatars and users avatars will influence consumer attitudes and behaviors in the Metaverse, which may warrant empirical investigation. Given the use of virtual possessions or assets in the Metaverse, constructs such as attachment, scarcity, ownership, and asset disposal [9] would also require further investigation.

Mass Market: Commercial Metaverse

Commercial Metaverse and consumer Metaverse applications and business models are not necessarily mutually exclusive. Although we classify metaverses primarily developed for hedonic purposes as consumer metaverses, we consider transaction-oriented or productivity-oriented applications to be the commercial Metaverse. The commercial Metaverse enables organizations to find new ways to engage with customers, employees, suppliers, and other organizations.

Commercial Metaverse Emerging Market Segments

From a retail perspective, the commercial Metaverse holds the potential to evolve as a creative extension of the virtual shopping experience, which saw an unprecedented surge of interest during the pandemic.[12] Retailers have long been engaging customers in the virtual world by enabling them to browse, purchase, and communicate their needs without physical contact; however, the Metaverse could enhance this engagement and elevate the resulting consumer experience to an entirely different level. The affordances of the Metaverse can influence brand attitudes, shopping enjoyment, and consumer trust and further improve shopping experiences compared to conventional virtual shopping. For instance, virtual "try-on" systems, more realistic product presentations in 3D, and high immersion features such as presenting products in the immediate user environment can provide near real-world shopping experiences for consumers [77].

Beyond retail, experiences are also an emerging market segment in the commercial Metaverse. For instance, opportunities exist for virtual open houses, property tours within the real estate industry, cooking classes, and tourism experiences within the Metaverse.[13] More specifically, many are excited about the possibility of engaging in experiences via the Metaverse. For example, scholars in the tourism industry have considered how the Metaverse can allow people to visit locations that are difficult or prohibited to access and offer interactive experiences within both the physical world and the virtual world [91]. An entire tourism ecosystem can emerge to support tourism within the Metaverse to support travelers before, during, and after travel, whether that travel occurs in the physical world or within the Metaverse [12].

Organizations are identifying creative ways to support employee learning and engagement in workplace settings. Accenture replicated its offices and labs worldwide within a Metaverse to onboard employees, reduce travel needs, and support client meetings.[14] Various workplace applications have been developed for collaboration, meetings, and workplaces. Software solutions like NextMeet help remote workers feel less isolated from the workplace, and PixelMax enables workers to more easily "bump into" one another in virtual environments.[15] These two solutions do not require users to wear headsets or goggles to have these collaborative experiences with colleagues. Other companies are investing in XR solutions for more immersive collaborative experiences, such as Meta (e.g., Meta Horizon Workrooms), Viverse (e.g., VIVERSE for business), and Microsoft (e.g., Mesh).

Commercial Metaverse Limitations and Challenges

When engaging with the commercial Metaverse, customers want experiences that offer a connection to the physical world or their daily lives in some way.[16] This requires organizations to engage in a delicate balance of providing innovative virtual offerings within the Metaverse with some virtual elements. Still, these elements cannot be removed from customers' reality too far. Research has identified that higher levels of immersion when using technologies such as VR can lead to positive outcomes, such as a stronger sense of telepresence and enjoyment, but can also create problems when engaging in diagnosticity tasks in a retail environment [70]. Limitations of the hardware and software can create constraints on how well the person can engage with tasks and may affect their purchasing patterns. Therefore, organizations must carefully consider their customers' or clients' use cases and shopping patterns when designing these tools.

The duplicative and alternative representations of the physical world within the Metaverse can offer positive benefits to customers, employees, suppliers, and organizations; however, harmful activities in the physical world also exist in the Metaverse. Commercial criminal activities also occur in Metaverse environments, including counterfeiting, scams, tax evasion, cyber-physical burglary, trespassing, and money laundering [34]. Organizations must engage in activities to protect their organization in the physical world and their brand identity, intellectual property, employees, and customers within the Metaverse.

Commercial Metaverse Use Cases

The commercial Metaverse can provide different retail environments to enrich and redefine the shopping experience [43]. First, the brand experience space immerses users [64] in a branded environment, allowing them to engage deeply with a brand's identity, story, and values through interactive, sensory-rich encounters. Second, the sales space enhances product accessibility, enabling users to browse and explore items in an intuitive, virtual setting, removing geographical or logistical barriers to access. Third, store virtualization transforms traditional 2D catalogs into dynamic 3D experiences, offering consumers a unique opportunity to interact with products as though they were physically present, significantly aiding decision-making. Lastly, purchase support addresses the challenges of virtual post-purchase assistance, providing users with seamless, accessible support options in the Metaverse to handle issues like returns, queries, and troubleshooting, which have historically been limited in virtual retail environments [43]. Together, these environments elevate the online shopping experience by blending the convenience of e-commerce with the engagement of in-store shopping. These examples show how Metaverse platforms can be used effectively in digital marketing [2, 62] and consumer engagement strategies [80].

Corporate education and training are additional use cases for the commercial Metaverse, particularly in enterprise settings, as it can effectively replicate hands-on experiences, unlike traditional content delivery via lectures, text, or video. The biggest advantage of Metaverse training is that it supports repeating tasks at no additional resources until the trainee has attained the desired level of mastery, which offers a higher degree of freedom to learn the task or concept [47]. Complex, potentially dangerous, and extraordinary tasks can be effectively practiced in the Metaverse [33].

Commercial Metaverse Opportunities for Business Models and Research

Metaverse business opportunities abound, as is evidenced by the investments made by technology companies including Meta, Microsoft, and Nvidia, entertainment brands like Disney, retail giants such as Nike, Gap, Tommy Hilfiger, and Gucci, as well as fast-food chains such as Wendy's and McDonald's [9]. As laws of the natural world do not entirely apply to the Metaverse, brands are empowered to make creative and imaginative offerings that do not exist in the real world [29]. For instance, the luxury brand Gucci partnered with

ZEPETO to allow users to dress their avatars in pieces that may be available physically.[17] The Metaverse offers new enables digital to physical purchases, such as customers purchasing an item in the Metaverse that they use in a physical world, and physical to virtual purchases, such as receiving a code after purchasing a physical product to unlock avatar customization in the Metaverse[18] NFTs are also evolving into a new form of hybrid user experiences [6], which offers new revenue streams by creating scarcity for a digital product. The lines blur between consumer Metaverse applications and commercial Metaverse applications as organizations identify how to reach best and market to consumers in the Metaverse.

Regarding research, various areas of customer engagement, behaviors, and elements of trust and social interactions pose exciting questions. Metaverse interactions offer users varying hedonic (pleasure-oriented) and utilitarian (practical) values. The role of this dual-process decision-making, driven by a complex interplay of emotions and cognition within a digital environment, represents an important avenue for future research [73]. Customer touchpoints in the Metaverse, namely economic and social exchanges, social relationships, and direct environment interaction, need to be investigated separately for the three main stakeholders, namely consumers, retailers, and brands, through the length of the entire customer journey from pre-purchase, purchase to post-purchase [95].

Expert-Driven Niche Market: Industrial Metaverse

The industrial Metaverse, also known as Industry 5.0 [37, 56, 98], represents the integration of digital and physical domains within industrial contexts, facilitating interactive, real-time, and immersive experiences. It combines technologies to enable simulation, monitoring, and predictive analytics, offering opportunities for operational optimization, enhanced collaboration, and innovation. *Digital twins* are central to this concept, virtual replicas of physical assets and processes that provide real-time insights. However, the industrial Metaverse extends beyond these replicas to reflect an entire organization's operating environment. It integrates the value chain, product lifecycle, processes, machines, materials, and people in a bi-directional flow between the virtual and real worlds, fostering a connected and responsive ecosystem [59]. The industrial Metaverse relies on the IoT to collect data from connected devices for advanced or real-time analysis—mainly because of the reliance on advanced sensors, advanced optics and cameras, and robotics. Integrating AR, VR, MR, and XR technologies, alongside other advancements such as blockchain, machine learning, AI, and next-generation communication networks like 6G, further enriches user interaction, providing immersive training, design, and maintenance environments [45, 98]. These technologies collectively enable a seamless interaction between physical systems and digital environments, offering immersive training, remote operations, and real-time optimization capabilities.

Industrial Metaverse Emerging Market Segments

The industrial Metaverse is defined by its ability to accurately replicate real-world elements such as machinery, factories, buildings, cities, and power grids within a virtual environment [45]. These highly detailed digital representations enable seamless interaction between physical and virtual systems, forming the foundation for advanced simulation, monitoring, and predictive capabilities. A vital characteristic of the Industrial Metaverse is the integration of humans, machines, and materials in a bi-directional flow of information, enabling real-time coordination. This feature facilitates rapid detection and resolution of problems, improving efficiency and reducing downtime [32, 98]. The Metaverse enables streamlined workflows and enhanced stakeholder collaboration by connecting diverse components of industrial operations.

The industrial Metaverse also accelerates critical manufacturing processes. For example, it simplifies and speeds up repairs by identifying issues through advanced diagnostics. Remote monitoring capabilities allow supervisors to oversee operations across multiple locations in real-time, reducing the need for on-site visits. It supports the rapid launch of new manufacturing lines by testing and optimizing configurations virtually before physical implementation. Furthermore, simulation-based training provides immersive experiences for users and managers, enhancing their skills and decision-making abilities in safe, controlled environments [63]. These traits can lead to advantages such as improved operational effectiveness, lower expenses, enhanced security, and quicker product release times. As the industrial Metaverse evolves, it holds the potential to transform industries, fostering innovation and sustainability while addressing complex industrial challenges.

Industrial Metaverse Limitations and Challenges

Although promising transformative opportunities, the industrial Metaverse faces significant limitations and challenges that must be critically addressed for widespread adoption. One key issue is the increased complexity and risk associated with heterogeneous ecosystems, which can exacerbate disparities across industries with varying technological maturity [11]. The Metaverse architecture is inherently complex, requiring seamless integration across all enterprise layers and processes. Beyond interoperability challenges, this integration does not necessarily reduce task complexity and may impose additional burdens on organizational infrastructure [63].

Similar industry challenges highlight the need for a comprehensive framework to identify risks and enabling factors for future research and practical applications [11]. Furthermore, ethical and legal concerns, such as data ownership, privacy, and governance, pose barriers to adoption, particularly as organizations navigate compliance and accountability issues [98]. Addressing these challenges will require interdisciplinary efforts, strategic policy development, and robust technological innovations to ensure equitable and sustainable Metaverse integration.

Despite its promise, the industrial Metaverse is still in its infancy and requires extensive research to address existing challenges, including technological integration, data security, and organizational readiness [93]. This is because it adds a layer of complexity in terms of the need for supporting fault tolerance, supply-chain management and sourcing, supply-chain resiliency, physical industrial machines, cyber industrial machines, power grids, raw materials acquisition, safety, sustainability, logistics, manufacturing, and product service generally not seen in mere consumer or e-commerce contexts [37, 98]. Moreover, because of the global nature of supply chains, there is added complexity when considering legal contracts, intellectual property laws, resolving legal disputes, labor, cultural conflicts, provisioning, statutory requirements, taxation, blockchain, and payment. Thus, realizing its full potential depends on advances in supporting technologies and establishing standards and frameworks to ensure interoperability and scalability.

Industrial Metaverse Use Cases

Industrial Metaverse technologies facilitate optimization through connected ecosystems in supply chain operations, enabling improved resilience and streamlined processes. For product engineering, immersive design and testing tools allow for early identification of defects and iterative improvement, reducing time-to-market. Furthermore, applications like product visualization and customer demonstrations drive engagement, with digital twins as crucial enablers. For instance, critical use cases for machine operation include manufacturing process planning, as manufacturers use digital twins to optimize production lines [56]. Predictive maintenance, powered by digital twins and real-time analytics, minimizes downtime and maintenance costs and can improve operational reliability. The training of (autonomous) machines and the modeling of production also offer promising use cases for the industrial Metaverse.

Workforce operations critical use cases comprise immersive training and remote collaboration tools to enhance workforce capabilities, fostering safety and efficiency while mitigating geographic constraints. Examples are the case of maintenance workers undergoing VR training for complex procedures [19]. Real-time collaborations with AR /VR will enable immersive interactions between collaborators and machines–and often also multimodal [19]. Voice agents offer vast potential for boosting service outcomes—such as allowing hands-free and conversational interactions with backend systems [101]—and are vital for almost all human-industrial Metaverse use cases.

Industrial Metaverse Opportunities for Business Models and Research

The industrial Metaverse presents a transformative landscape for business models, offering opportunities to enhance operational efficiency, innovation, and customer engagement. By integrating digital twins—virtual replicas of physical assets—companies can simulate and optimize manufacturing processes, reducing downtime and improving productivity. This virtual-physical convergence enables predictive maintenance and real-time monitoring, fostering data-driven decision-making for many stakeholders. The Metaverse can also facilitate immersive training environments, allowing employees to gain skills in a low-risk setting that reduces training costs and enhances workforce competency.

Customer engagement is also redefined through virtual showrooms and interactive product demonstrations, providing personalized experiences that can drive sales and brand loyalty. Additionally, the Metaverse supports collaborative innovation by connecting stakeholders in a shared virtual space, accelerating product development cycles, and fostering co-creation. These opportunities necessitate the development of new revenue streams, such as subscription-based access to virtual platforms and monetizing digital assets. However, realizing such benefits requires massive technology and infrastructure investments and a strategic mindset focusing on digital transformation rather than mere adoption or innovation. As the industrial Metaverse evolves, businesses that proactively adapt their models to leverage its capabilities are poised to gain a competitive advantage in the digital economy.

Expert-Driven Niche Market: Healthcare Metaverse

The healthcare industry is considering leveraging the healthcare Metaverse to improve patient care, rethink hospital operations, provide more vigorous healthcare training and education, and evaluate new opportunities for service delivery. As hardware, software, and telecommunications technologies continue to improve, the Metaverse offers the promise of new possibilities [17]. One of the benefits of leveraging the Metaverse is the ability to overcome geographic limitations, which can broaden access to healthcare for patients and expand training opportunities for clinicians [8]. Furthermore, a healthcare Metaverse can provide a more patient/clinician immersive experience compared to traditional telemedicine and allows for more opportunities to collect patient data unobtrusively [24]. The healthcare industry has unique affordance requirements that need consideration for Metaverse applications because some tasks require physical, real-world interaction, and others can be virtualized, not to mention there are unique industry, ethical, and legal requirements to be considered [25].

Healthcare Metaverse Emerging Market Segments

Some of the most widely recognized opportunities for the Metaverse are to support education and training for future or current clinicians. The Metaverse allows for providing immersive scenarios to plan for disasters, emergency responses, or simulated surgeries [50, 83]. Medical students can benefit from additional training opportunities through Metaverse applications [17]. Surgical training using the Metaverse or other immersive technologies has been developed for fields like ophthalmology, orthopedics, plastics, neurology, and cardiology [50].

Researchers and practitioners are considering how clinical services can be delivered through or augmented by the Metaverse. Metaverse applications and immersive technologies have been used to help patients needing support for their mental health to address phobias, reduce anxiety, or improve mental well-being [25]. The Metaverse is being studied to support patients who want anonymity when receiving mental health treatment [82]. Literature reviews have documented studies that have used Metaverse or immersive technologies for physical rehabilitation and exercise programs [25]. Proposed opportunities to leverage the Metaverse to support more immersive experiences to observe and analyze data on patient health gathered through remote patient monitoring [92] or observation [28].

The healthcare Metaverse has also been proposed to improve the healthcare industry, and some of these applications are essentially adaptations of the industrial Metaverse for healthcare. For example, the Metaverse may be used to simulate and understand business procedures and activities within hospitals [92]. Others have acknowledged the potential of using metaverses and the related technology to enable and support alternative healthcare care business models, such as value-based care [24].

Healthcare Metaverse Limitations and Challenges

Literature reviews examining the use of the Metaverse in healthcare applications have identified multiple challenges and concerns. Given the sensitivity of healthcare data, information security, and privacy are critical [83]. The Metaverse does not have geographical boundaries, but there are legal impacts based on where the patients or services are located; as a result, organizations leveraging the Metaverse must still comply with legal frameworks and regulations, which can be complex in a virtual world without boundaries [60, 83]. System interoperability can be critical, particularly when the Metaverse supports patient and clinician interactions. There needs to be the ability to access the patient's medical or personal data [83]. Some have also acknowledged that it is essential to ensure that healthcare applications of the Metaverse do not exacerbate or create new health problems, such as eye strain, seizures, falls in the physical environment, or adverse effects on one's mental health [31]. Finally, although there are many ideas or examples of the feasibility of healthcare Metaverse apps (or the use of technologies that often support the Metaverse), there are limited examples of how the Metaverse has been applied in healthcare settings at scale.

Healthcare Metaverse Use Cases

Healthcare is leveraging the advancements of technologies that enable the more immersive aspects of the Metaverse, such as VR, AR, MR, and XR. For instance, AR has been used to project and display patient anatomy during surgery; in contrast, VR has been used to create 3D models of anatomical structures to educate students, prepare for complex surgical interventions, or model new pharmaceutical structures [8]. Several of these emerging technologies involve foundational technological enablers of the Metaverse, such as VR or MR, but have not yet evolved into proper Metaverse applications.

The COVID-19 epidemic altered many clinician and patient interactions, leading to increased offering and using telehealth services [88]. Therefore, another use case is considering how healthcare metaverses can provide an immersive alternative to services currently served via telehealth and telemedicine [25, 92]. This has been of particular interest for certain types of patient and clinician interactions, such as pre-surgery consultations, therapies to reduce the impact of phobias or post-traumatic stress disorder, and reducing stress among obstetrics patients [8].

Healthcare Metaverse Opportunities for Business Models and Research

In considering the future of research and practice for healthcare metaverses, addressing sociotechnical issues associated with using metaverses in healthcare will be necessary. Whereas the Metaverse can address geographical limitations that frequently occur in healthcare settings, the users (patients, clinicians, students) must have access to the technology, sufficient telecommunications bandwidth, and comfort with the hardware and software required to use the Metaverse [8]. What new digital and digital health divides may emerge as some populations have more access to Metaverse applications while others have less access? Little research has also identified Metaverse adoption enablers and barriers to healthcare [76]; yet, this is essential research with profound implications for healthcare practice.

Addressing the current limitations of the healthcare Metaverse is critical to further adoption, which offers potential for research and practice. Design science-based research can inform the design of metaverses used for clinician and patient encounters [97]. Because healthcare focuses on improved clinical outcomes, well-being, and quality of life, user/patient trust is even more vital in this market than most. Due to the nature of the healthcare field, compounded by confidential information, the emphasis on data security and privacy is heightened. One opportunity is the integration of technologies within healthcare metaverses, such as blockchain, to address concerns related to data security and interoperability directly [50].

Moving Toward Intersectional Opportunities

Summarizing our review, our operating premise is that these four markets naturally will evolve out of their current physical and e-commerce manifestations, such that the initial business models will be generally expected. However, we envision that the more compelling

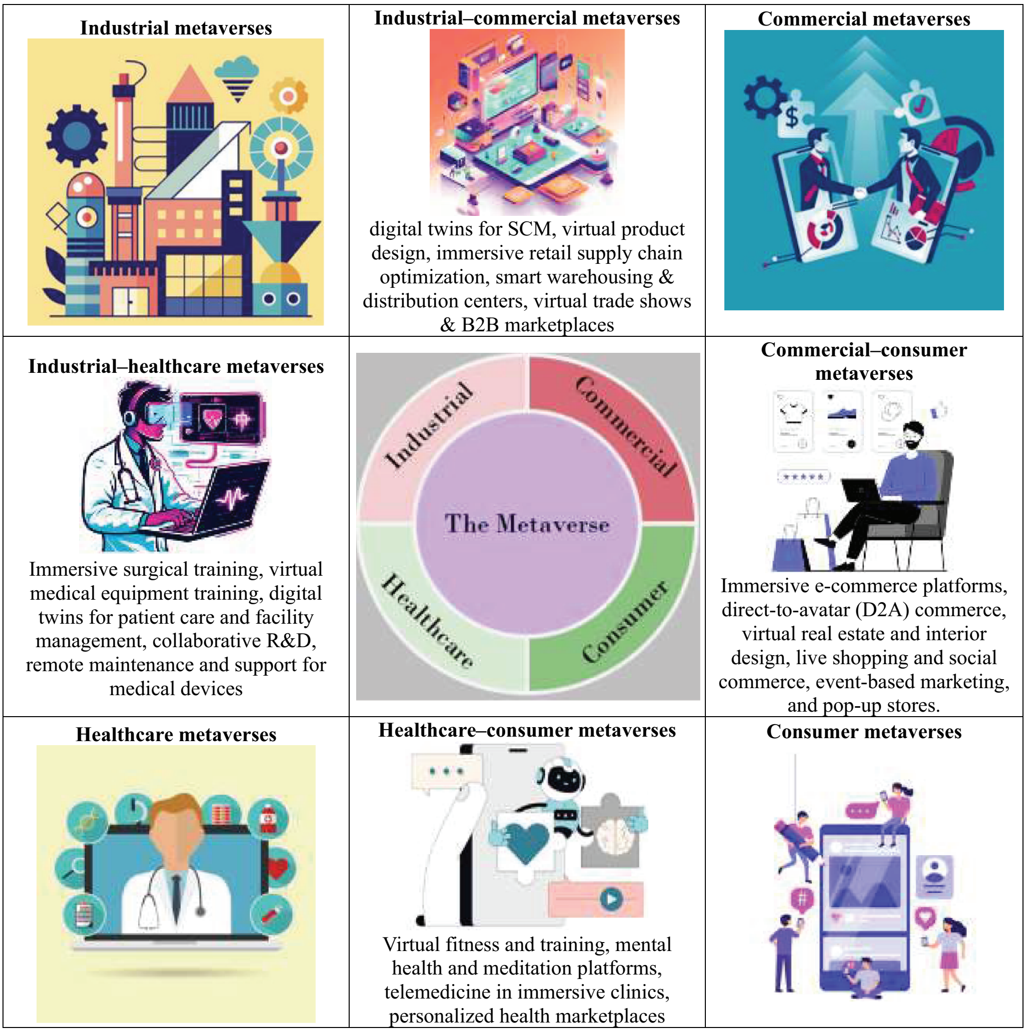

Figure 2. Intersectional research and business opportunities in the four major metaverse markets.

research and business model opportunities likely are in the intersection of the possibilities of these four metaverse markets, creating four compelling intersections: industrial-commercial, commercial-consumer, industrial-healthcare, and healthcare-consumer, as we illustrate in Figure 2.

Application to the Articles within the Special Issue in the Metaverse

This special issue was created to inspire and support emerging research exploring different facets of the Metaverse. Seven articles emerged from a rigorous screening and review process. Each article offers insights into theory and practice and explores various aspects of consumer and commercial market segments within the Metaverse. Next, we overview each paper and provide additional thoughts on the future research that we believe each paper inspires.

Consumer Metaverse Applications

Three articles in this special issue address issues specific to the consumer Metaverse by exploring consumer experiences with gaming, sports, and everyday life.

Valuing Metaverse Gaming Experience

In "Demystifying the dimensions and roles of Metaverse gaming experience value: A multi-study investigation," Zhou et al. [100] define Metaverse gaming (MG) experience value (MGEV) as players' holistic assessment of the quality and enjoyment of their experiences in MG. Despite the potential of MG, player penetration remains low, and many users report suboptimal gaming experiences. The lack of research on context-specific dimensions of MGEV, particularly its multidimensional nature, has limited efforts to improve player engagement and satisfaction in MG. This is important to address because MG is a rapidly growing industry with significantly projected economic growth. Extant research has failed to fully capture the unique characteristics of MG, which involves complex interactions between players, game content, the surrounding environment, and service providers. The paper develops a comprehensive and context-specific typology of MGEV that reflects the unique dynamics of MG, facilitating improved design and player experience.

The authors conducted a comprehensive multi-study investigation combining qualitative coding, machine learning, and econometric analysis to understand the dimensions and roles of MGEV in MG. The findings yield a theoretical foundation for further research into the nuanced roles of MGEV in MG. The authors combine motivation-focused and activeness-focused perspectives to offer a more comprehensive view of MGEV in the MG context. By taking a perspective that focuses on the player's experience rather than following the variable-centered methods commonly found in existing research, the study identifies distinct MGEV profiles among different player groups, revealing how diverse experience values influence player behavior and engagement in MG. Beyond the authors' vision of future research, we see several other compelling opportunities to build on their work, including but not limited to what we propose in Online Supplemental Table 1.2.

Meta-Sports in the Metaverse

Westmattelmann et al. [87] advance their understanding of meta-sports by examining how athletes perceive the fairness of algorithm-driven competitions in the article "Exploring the new playing field: The input-output principle of meta-sports." Meta-sports, which replicate physical sports in immersive virtual environments, have rapidly emerged within the Metaverse. However, the transition from physical to virtual sports raises questions about competition's perceived fairness, primarily because meta-sports rely on algorithm-driven input-output systems. The opaque nature of these algorithms can lead to concerns about distributive justice, which in this context is the perceived fairness of how competition results (outputs) are distributed based on athletes' performance (inputs).

The researchers performed a comparative mixed-methods study using data from the German Virtual Cycling Bundesliga (GVCB), a meta-sports platform hosted on Zwift, across two competition years (2020 and 2021). The study collected and analyzed objective data from the platform in addition to survey and interview data from athletes. The findings identify transparency and fairness as crucial factors for success.

As meta-sports evolve, ensuring that athletes understand and trust the input-output systems will be vital to fostering broader adoption of virtual sports platforms. The authors detail how meta-sports platforms can be designed to increase the likelihood of transparent and fair competitive environments, which is critical for the long-term success and adoption of meta-sports. Aside from the authors' vision of future research, we believe several compelling research opportunities are detailed in Online Supplemental Table 1.3.

Everyday Metaverse

In "Everyday Metaverse: The Metaverse as an integral part of everyday life," Wang et al. [84] reshape the concept of the Metaverse as one that can be seamlessly woven into our daily existence. Their concept of an "everyday Metaverse" challenges the assumption of the Metaverse as a digital realm detached from our daily personal and work routines. The central challenge is figuring out how to construct the Metaverse that smoothly combines the physical realms by enabling users to move between these two spaces, ultimately transforming the Metaverse into an organic extension of daily existence.

The researchers conducted a detailed case study to examine how a hybrid urban project incorporating Metaverse technologies was developed and implemented in the routines of city dwellers. This approach enabled the researchers to witness how designers navigated the complexities of merging virtual and tangible environments within a practical urban context. Through a rigorous analysis of the data collected, the authors identified fundamental processual mechanisms involved in designing the *everyday Metaverse*. Based on the findings, the researchers created a theoretical framework that offers a new outlook on integrating the Metaverse into daily life following their discoveries. This framework emphasizes the need to transcend digital-centric approaches and create fluid, intuitive transitions between the digital and physical worlds. Based on their work, in Online Supplemental Table 1.4, we provide further future research opportunities that we envision for the everyday Metaverse.

Commercial Metaverse Applications

Four articles in this special issue address issues specific to the commercial Metaverse and examine business models, retail experiences, workplace experiences, and financial transactions.

Metaverse Business Model Value Drivers

Krüger et al. [44] identify critical sources of value creation for metaverses and compare them to traditional digital ecosystems in their article, "Value drivers for Metaverse business models: A complementor perspective." This paper offers theoretical and practical insights to help firms navigate and succeed in the evolving Metaverse landscape. Precisely, the article pinpoints factors that drive value for business models in the Metaverse by focusing explicitly on complementor firms that -create value on Metaverse platforms by offering products or services that complement the core platform offerings. Despite the growing interest in the Metaverse as a digital frontier for value creation, significant ambiguity remains surrounding its value potential due to its early development stage. Many companies are unsure how the Metaverse can create value despite its benefits. The hesitance is heightened by the fact that leading companies, like Meta and Disney, are reducing or shifting their investments as returns fall below expectations.

The authors conducted case studies of 29 firms actively engaged as complementors within the Metaverse ecosystem. These firms span various industries and offer complementary products and services in virtual environments. The authors expand on existing business model literature by distinguishing Metaverse value drivers from those of e-business models, emphasizing that replicating traditional models in virtual environments misses the Metaverse's unique opportunities for innovation and value generation. Aside from the authors' vision of future research opportunities, we believe their work offers several intriguing possibilities, as outlined in Online Supplemental Table 1.5.

Multichannel Retail using XR in the Metaverse

In "Beyond the screen: How the Metaverse is reshaping multichannel retail through XR adoption and the delicate balance between complementarity and substitution," Xiong et al. [90] examine how the adoption of XR technology in online portals influences the performance of physical (offline) stores within multichannel retail environments. As retailers invest in online and offline channels, there is a pressing need to understand how XR adoption influences offline store performance. XR technology can create synergies between online and offline channels or replace offline channels due to enhanced virtual experiences. This research examines the time-varying influence of XR adoption on offline store performance, offering retailers guidance on optimizing their channel strategies in the evolving Metaverse landscape.

To study this phenomenon, the authors analyzed 667 multichannel retailers' online and offline performance metrics. The dataset includes 11,643 monthly observations from 2019 to 2022, tracking retailer-level XR adoption, offline store characteristics, and online traffic patterns. The authors infer the causal impact of policy or technology adoption over time through staggered difference-in-differences (DiD) models. The authors also examine the role of offline store density, reflecting the concentration of physical stores in a region and the influence of this density on the relationship between XR adoption and offline store performance. High store density may reduce the substitution effect of XR adoption by lowering the switching costs between online and offline channels. This research offers a contingent examination of XR technology by distinguishing between enhancement XR (improving interaction capabilities) and creation XR (replicating or generating virtual products in real-life scenarios). The findings enhance our comprehension of how XR technology can substitute for or complement retail channels. Aside from the authors' vision of future research opportunities, we believe their work opens several other compelling opportunities, as outlined in Online Supplemental Table 1.6.

Metaverse as a Workspace

Organizations considering leveraging the Metaverse within the enterprise have often focused on how the Metaverse can enable remote collaboration and workspaces. In "Working from the Metaverse: A distraction management perspective," Marx et al. [57] choose a different approach by studying how immersive Metaverse workplace applications can diminish or exacerbate distractions for knowledge workers engaged in solo tasks. By focusing on tasks instead of teamwork in virtual reality settings, the authors examine the mechanisms knowledge workers use to manage distractions when working in a virtual workspace. They followed a two-phase qualitative methodology to understand distraction management better.

The interventions and interviews from this research revealed new theoretical concepts developed using grounded theory principles. The first new concept, distraction shielding, explains how knowledge workers proactively shape their virtual work environment to protect themselves from distractions. Arousal filtering, the second new concept, describes the cognitive efforts of workers to process and react to potential distractions originating from the virtual environment. The authors propose a theoretical model of virtual workplace distraction management to explain how knowledge workers can navigate and manage distractions while performing solo work in the Metaverse. Beyond the possibilities for future research identified by the authors, we identified several additional opportunities outlined in Online Supplemental Table 1.7.

Decentralized Metaverse Economies

In their article, "Foundations of decentralized Metaverse economies: Converging physical and virtual realities," Hanneke et al. [39] addresses the need to understand the economic foundations of decentralized Metaverse economies. The authors examine how exchange rates influence economic activity and how traditional economic concepts like scarcity and ownership may be perceived differently within virtual economies. Recognizing that many virtual economies rely on centralized operators, this study examines the effects of decentralized ownership and scarcity limitations using blockchain-based economies within the Metaverse.

The authors analyze over 4.5 million transactions from "The Sandbox," one of the largest blockchain-based metaverses, to examine how exchange rates influence economic activity and the participation of economic actors in a decentralized economy. Hanneke et al. [39] leveraged a vector autoregressive model to explore the dynamics between exchange rates and economic activity. The results reveal that higher exchange rates correlate with more economic activity and actor participation, as well as the presence of trade-offs that occur with higher exchange rates, including potential barriers to entry. Given their findings, they propose a new conceptual framework for understanding decentralized Metaverse economies by integrating principles from real, virtual, and blockchain economic systems. This work clarifies blockchain's role in enabling decentralized digital ownership and scarcity. It demonstrates how shifts from centralized to decentralized control in virtual economies could affect the dynamics of these marketplaces. Beyond the authors' compelling suggestions for future research, we believe their work inspires several other compelling opportunities, as detailed in Online Supplemental Table 1.8.

Expanding Horizons: Research Directions in Understanding the Metaverse

The critical challenge we see as Metaverse researchers is to unpack its black-box nature better and engage in specific research discourses that address meaningful questions raised in research and practice. To do this meaningfully, embracing its sociotechnical nature and being more systematic and mindful of the choices is crucial. Building on related previous design, artifact, and theory guidance in other sociotechnical contexts [1, 16, 23, 36, 40, 41, 46, 53], it is essential to engage in five practices to foster high-impact Metaverse research, which we summarize in Figure 3.

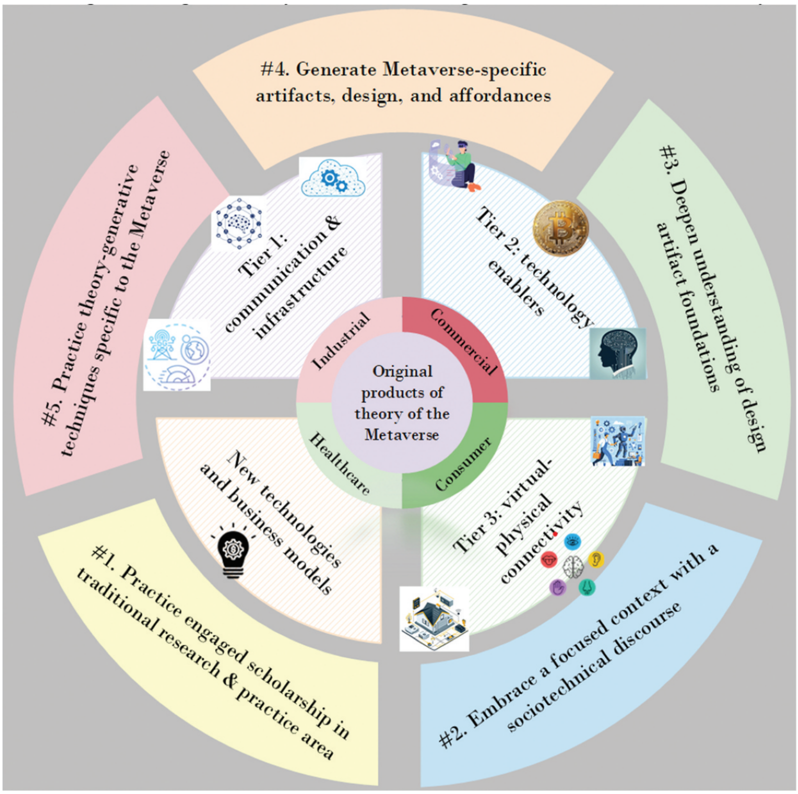

Figure 3. Design thinking and theory generation for original metaverse products of theory.

#1. Engage in one's traditional area: Researchers new to the Metaverse should likely start by practicing engaged scholarship with one's traditional area of research practice in trying to address Metaverse-specific questions that matter to that practice, whether this is Computer science, IS, Finance, HCI, Management, Marketing, Education, Law, Security, Ethics, Gamification: Gaming, Social psychology, or Design science.

#2. Embrace an interdisciplinary sociotechnical discourse: Once researchers start in their natural research area, we suggest they build on that foundation by actively embracing the interdisciplinary "sociotechnical Metaverse" discourse in research and practice. Here, we recommend:

- Being *aware* of the Metaverse discourse and engaging in appropriate conversation with the literature
- Making deliberate *context choice*s with a focus on *sociotechnical* ramifications
- Practicing interdisciplinary *engaged scholarship* with other discourses and practice
- Embracing *curiosity* and *collaboration* with new and related discourses

#3. Deepen understanding of design foundations: A critical problem with researchers new to the Metaverse is that they often treat the underlying technologies as a "black box" or apply superficial design representations. We argue that to be successful in this area, one needs to try to unveil that black box and embrace design fundamentals from other researcher discourses, such as AR, MR, and VR, that may create the building blocks of the Metaverse. Here we recommend:

- Focusing on creating prototypes
- Embracing aesthetics & beauty
- Conducting research that involves user-centered participation
- Engaging in frequent iteration
- Leveraging avatars and virtual representations
- Considering invisible interfaces or hidden affordance
- Embracing and expanding concepts like engagement, flow, and telepresence
- Drilling into Metaverse-specific technologies or those required to make it successful (unveil the black box and understand the various layers)
- Understanding the relative importance of underlying building block technologies

#4. Generate Metaverse-specific artifacts, designs, and affordances. Researchers can actively create Metaverse-specific artifacts, designs, and affordances with a good design foundation and preliminary understanding of the design and research issues in a sociotechnical Metaverse discourse. Here, we recommend:

- Challenging and refining the Metaverse design artifact
- Problematizing the research to raise Metaverse-specific questions in the chosen research discourse, especially concerning sociotechnical design issues involved
- Building and broadening Metaverse artifactual thinking
- Applying affordance thinking and creating Metaverse-specific affordances
- Applying design science to market segments and business models to solve actual problems

#5. Practice theory-generative techniques. Finally, no area of research can thrive without discourse-specific products of theory, and thus, it is crucial to practice techniques that generate products of theory and theory itself [40, 41]. These include engaging in systematic metaphorizing, leveraging analogies, conducting systematic literature reviews, creating original conceptualization of Metaverse-specific concepts, developing contextualized measures of the original concepts, creating typologies and taxonomies, applying mixed-methods and qualitative research, leveraging meta-analysis, and engaging in grounded theory and engaged scholarship.

Unpacking Context Specificity and Physical-Digital Linkages in the Metaverse

The papers in this special issue highlight the importance of examining the unique characteristics and complexities of the Metaverse as a context for research, especially given its sociotechnical nature and the need to develop theory, affordances, design, and products of theory to support its study [40, 78]. The specificity of the Metaverse's technological and contextual dimensions demands tailored theoretical approaches to unravel its nuances. For instance, Westmattelmann et al. [87] demonstrate the need to translate physical activities into virtual environments by employing a justice perspective to explore how perceptions of fairness and unpredictability shape user engagement and commitment in meta-sports. This underscores the importance of fairness in designing algorithmic rules that govern the translation of physical actions to virtual contexts, a key consideration for Metaverse developers. Likewise, Zhou et al. [100] show the importance of understanding what Metaverse gaming users value and personalizing and segmenting the design of the gaming experience accordingly. Such studies reveal the need for IS researchers to open the "black box" of the Metaverse to understand better how its unique attributes and use cases challenge existing theories and call for novel applications or extensions.

Future studies should also explore how the physical and digital realms interact in the Metaverse. This extends to investigating how virtual and physical performance outcomes compare, as seen in the training potential of meta-sports [87], and exploring how digital brand identities align with their physical counterparts [87]. A compelling opportunity is to study how consumers view products differentially based on whether they come across the brand in a virtual or real-world setting and how these views influence their brand loyalty. With the Metaverse enabling "digital-first" business models where virtual assets precede and define their physical counterparts, scientists could explore how such models reshape consumer expectations and business strategies. Wang et al. [84] emphasize the importance of seamless transitions and intuitive interfaces for integrating the Metaverse with physical reality. This invites future studies to investigate adaptive interfaces that autonomously respond to situational cues, uncovering how intuitive, context-aware interactions influence user engagement and satisfaction in everyday Metaverse experiences.

Additionally, the special issue highlights the Metaverse's capacity for customization, tokenization, and economic structuring, which raises questions about user autonomy, motivation, and economic behavior. Marx et al. [57] suggest that affordance customization—such as granular control over virtual environments—could enhance perceived autonomy and engagement in virtual workspaces, a direction ripe for further exploration. Similarly, with the rising interest in digital assets, future research could examine how tokenized rewards affect user motivation and fairness perceptions, drawing on experimental economics to optimize incentive design. Hanneke et al. [39] reveal that speculative activity often drives virtual economic exchange rates without fostering sustained engagement, prompting questions about how loyalty rewards or exclusive access might differentiate short-term speculative behavior from long-term participatory involvement. By addressing these areas, researchers can provide valuable insights into the evolving intersection of technology, human behavior, and economic systems within the Metaverse.

Evolving Technologies and Behaviors: The Case for Longitudinal Research on the Metaverse

The Metaverse remains nascent, with its underlying technologies, user behaviors, and economic structures expected to evolve significantly in the coming years. Current technologies, such as AR, VR, haptics, and emerging devices like olfactory interfaces, are still rudimentary but are anticipated to advance rapidly. As these innovations become more integrated into Metaverse experiences, they will likely transform user perceptions and behaviors, including intrinsic dimensions such as immersive sensory appeal and extrinsic aspects like device usability and ephemeral value. This evolution presents a compelling need for future research to adopt longitudinal approaches to capture how technological advancements and user interactions with the Metaverse change over time.

A longitudinal perspective offers unique opportunities to explore these dynamics in depth. For instance, as noted in Marx et al. [57], it is possible that knowledge workers adjusting to technologies such as distraction shielding and arousal filtering may have varying reactions and productivity outcomes in the long run. Understanding how such adaptations vary based on worker roles or task complexities could inform the design of future Metaverse environments to support sustained engagement and focus better. Similarly, Hanneke et al. [39] emphasize the potential for decentralized Metaverse economies to evolve, raising questions about how economic dynamics shift over time. Research could investigate whether early-stage incentives, such as tokenized rewards, remain effective as these economies mature or if new mechanisms will be required to retain users and creators in increasingly competitive ecosystems.

Researchers have a chance to explore if the impacts seen in today's Metaverse apps stay the same or evolve as users get used to the technology and what it can do. These findings help connect where the Metaverse is now with where it could go and provide advice for researchers and professionals aiming to create flexible and lasting Metaverse environments.

Understanding the Social and Personal Impacts of the Metaverse

The Metaverse introduces a new, immersive digital context likely to have profound social and psychological implications. As a novel environment for interaction, work, and leisure, the Metaverse raises important questions about its effects on individuals and communities, making this an essential area for future research. Scientists, for example, could study the psychological effects of continuous Metaverse engagement— including shifts in perception of reality, mental well-being, and social relationships. Platforms like Metaverse-based gaming [100] or everyday integrated Metaverse experiences [84] may reshape how users perceive and prioritize digital versus physical realities. Future research could examine how long-term engagement influences mental health and identify strategies to mitigate risks such as digital fatigue or dependency on virtual interactions.

Beyond individual impacts, the Metaverse also offers opportunities to redefine brand and customer relationships. According to Xiong et al. [90], XR encounters could increase customer loyalty toward brands even if they visit traditional stores less frequently. Research could focus on the factors that impact customer loyalty towards brands providing these XR experiences and assess whether these immersive interactions lead to long-term trust and preference changes over time. Similarly, in work-life integration, the Metaverse presents unique challenges. According to Marx et al. [57], The immersive environment of workspaces may lead to a blending of professional and personal boundaries that can make it challenging for people to separate work from personal life effectively. Researchers could thus explore strategies for boundary management, such as creating virtual "time-out" zones, setting access limits, or designing distinct environments for work and leisure to support well-being and balance. This could be particularly useful for more potentially addictive contexts like Metaverse gaming [100].

Moreover, long-term immersion in virtual spaces could impact intrinsic motivation, autonomy, and mental health differently than physical environments. Future studies might examine whether persistent engagement in virtual settings enhances focus and creativity or increases fatigue and burnout. Investigating these dynamics will be crucial to understanding how the Metaverse shapes personal and social behaviors, providing insights that can guide the development of safe, inclusive, and mentally healthy digital environments.

Ethics and Governance in the Metaverse: A Critical Frontier for Research

As the Metaverse evolves, ethical and governance issues become pivotal areas of inquiry, given this new digital ecosystem's profound and far-reaching implications. The lack of comprehensive understanding of the impact of the Metaverse makes it critical for researchers to address these topics, shedding light on balancing innovation with responsibility. For instance, Westmattelmann et al. [87] highlight the role of perceived fairness, suggesting a need for ethical transparency frameworks, such as fairness auditing and algorithm interpretability, to ensure competition outcomes are perceived as just. As Wang et al. [84] emphasize, the Metaverse produces a volume of sensitive information that requires governance structures to ensure privacy protection and ethical handling of data security. Future research could analyze the effectiveness of proposed solutions, such as blockchain-based privacy protocols and user-driven data management systems, in ensuring privacy and transparency within these continuously connected environments.

Governance also plays a vital role in managing business activities, protecting user rights, and overseeing content creation within the Metaverse. Research is needed to explore how firms navigate complex regulatory and ethical considerations, particularly concerning intellectual property, digital ownership, and data privacy. Developing governance models that balance business interests with user rights could provide best practices for regulating the Metaverse. Additionally, as Hanneke et al. [39] note, governmental involvement in digital economies influences asset quality and perceived value. Studies could examine whether government-sponsored asset creation fosters higher-quality or more innovative digital products than user-generated assets, shaping the long-term value of the Metaverse economy. Furthermore, the research could evaluate the effects of regulatory frameworks, such as the EU's Markets in Crypto-Assets (MiCA) regulation, on user participation, token value, and investor confidence, providing insights into how local versus global governance structures impact decentralized economies.

Another pressing concern is the potential environmental cost of operating the Metaverse, which relies on energy-intensive infrastructure to maintain its always-on presence. Exploring ways to lessen the impact on the environment in the Metaverse could involve incorporating energy sources and enhancing energy-efficient technologies while also focusing on crafting sustainable virtual products. Studies could also explore how consumer preferences for eco-conscious Metaverse engagement influence user loyalty and brand perception. Ethical concerns, such as digital waste reduction and equitable access to Metaverse resources, must also be examined to ensure that the Metaverse develops inclusively and sustainably. By addressing these ethical and governance challenges, researchers can provide a foundation for creating a Metaverse that balances innovation, equity, and sustainability.

Conclusion: A Call for Action and Thought Leadership Toward the Future

In this editorial, we describe how the Metaverse offers compelling opportunities for research and practice. We focused on two mass market segments: consumer and commercial. However, we did not explore governmental applications of the Metaverse, which could offer exciting opportunities to engage citizens as agencies and organizations provide services (e.g., smart cities, education). We also described two expert-driven niche market segments—industrial and healthcare—at different levels of maturity and reach. However, many other niche market segments likely have tremendous opportunities to disrupt the market, especially as Metaverse-native business models emerge.

Moreover, the social, cultural, psychological, and physiological impacts of sustained virtual collaboration and communication within Metaverse environments remain inadequately understood, raising concerns about user well-being and inclusivity [98]. The Metaverse can enable individuals to participate in society differently than before; however, there is a risk of social exclusion based on price points and disabilities that may limit access to the Metaverse. Because of its immersive interactions and expansiveness, the Metaverse affords an abundant array of deviant behavior, addiction, harassment, cyberbullying, and criminality—all of which are essential issues that researchers in the sciences of the artificial cannot assume away or ignore. IS researchers have a long history of developing theories, artifacts, interventions, processes, and designs to address such issues, and thus, we urge the IS community to lead in addressing these socio-technical issues.

Although researchers in the sciences of the artificial are deeply intertwined with practice, we caution researchers against being too reactionary or short-term in following and studying market trends. Although engaged scholarship with industry can generate excellent research ideas, a crucial role of scientists in the sciences of the artificial is not to be reactionary and market-driven but to envision and prepare for the future possibilities of the disruptive potential for emerging technologies once there is a convergence of technological and economic factors that will make the future a current reality. We must remove the blinders of current constraints, market demand, and technological limitations to act in our scientific role and see a generation or two ahead. Markets react to present conditions and are pressured to make short-term decisions to drive quarterly earnings and increase stock valuations. By contrast, scientists work to shape a better future unconstrained by immediate cost and feasibility issues. Thus, at best, it is short-sighted, and at worst, it is scientific malpractice for researchers to declare the Metaverse "dead" merely because short-term market forces have shifted profits and investments to generative AI or because quarterly earnings of firms declare aspects of the Metaverse as unfeasible. Our job is to envision and study the best of what the Metaverse can be and to strive to bring our future vision into the present. Such an understanding will also help to build the foundations of future technologies, which the Metaverse will likely evolve into.

Notes

1. Ashley Capoot (2024) "Meta loses $200 billion in value, Zuckerberg focuses on AI, Metaverse"CNBC.com (published April 24, 2024; last accessed November 23, 2024).
2. Neal Stephenson, Snow Crash (1992), Bantam Spectra.
3. Scott Porter, John Harrison, Adrian Ang, Rich Golich, and Sandeep Gupta (2022). "What's possible for the gaming industry in the next dimension?"EY.com (published 2022; US SCORE no. 15854-221US, Ernst & Young LLP; last accessed November 18, 2024).
4. Bernard Marr (2022). "The future of social media in the Metaverse," Forbes (published August 24, 2022; last accessed November 18, 2024).
5. Roblox (2021). "Ralph Lauren: The Winter Escape," Roblox Wiki (Roblox event that started December 8, 2021 and ended January 3, 2022; site last accessed November 18, 2024).
6. Juniper Research (2021). "Digital Adult Content: Market Forecasts, Key Monetisation Models & Emerging Technologies 2021-2026," (last updated August 2021; last accessed November 30, 2024).
   Allied Research (2023). "Adult Entertainment Market By Type, By Gender, By Age Group, By

Distribution Channel: Global Opportunity Analysis and Industry Forecast, 2023-2032," (last updated June 2023; last accessed November 30, 2024).

7. Tanya Basu (2021). "The Metaverse has a groping problem already," MIT Technology Review (published December 16, 2021; last accessed November 24, 2024).
8. Nokia (2024). "Meet the Metaverse generation," Nokia (published 2024; last accessed November 18, 2024).
9. Mary K. Pratt (2024). "18 real-world use cases of the Metaverse, plus examples," TechTarget (published March 27, 2024; last accessed November 18, 2024).
10. Jordan Ashley (2024) "All Fortnite Collabs - Every Crossover in All Five Chapters," esports.net (published November 21, 2024; last accessed November 24, 2024).
11. Manuel Bronstein (2023) "Introducing Experiences for People 17 and Older," Roblox (published June 20, 2023; last accessed November 24, 2024).
12. Mayumi Brewster (2022). "Annual retail trade survey shows impact of online shopping on retail sales during COVID-19 pandemic," United States Census Bureau (published April 27, 2022; last accessed November 26, 2024).
13. McKinsey & Company (2023) "Unlocking commerce in the Metaverse," McKinsey & Company (published June 8, 2023; last accessed November 23, 2024).
14. Kate Whiting (2023) "The 3 main ways we are using the 'Metaverse' explained," World Economic Forum (published February 17, 2023; last accessed November 24, 2024).
15. Mark Purdy (2022) "How the Metaverse Could Change Work," Harvard Business Review (published April 5, 2022; last accessed November 26, 2024).
16. McKinsey & Company (2023) "Unlocking commerce in the Metaverse," McKinsey & Company (published June 8, 2023; last accessed November 23, 2024).
17. Gucci (2022). "ZEPETO x Gucci: The House partners with ZEPETO, the app and social media to personalize avatars and create virtual worlds," Gucci (published 2022; last accessed November 18, 2024).
18. Cathy Hackl (2022) "Metaverse Commerce: Understanding The New Virtual To Physical And Physical To Virtual Commerce Models," Forbes (published July 6, 2022; last accessed November 23, 2024).

Notes on Contributors

Paul Benjamin Lowry (Paul.Lowry.PhD@gmail.com; corresponding author) is an Eminent Scholar and the Suzanne Parker Thornhill Chair Professor in Business Information Technology at the Pamplin College of Business, Virginia Tech, where he serves as the BIT PhD and Graduate Programs Director. He is an AIS Fellow, and a member of the AIS College of Senior Scholars and the AIS College of Academic Leadership. He is a former tenured Full Professor at City University of Hong Kong and The University of Hong Kong. He received his Ph.D. in Management Information Systems from the University of Arizona and an MBA from the Marriott School of Business. He has published 300+ publications, including 170+ journal articles in the Journal of Management Information Systems (JMIS), Information Systems Research (ISR), MIS Quarterly (MISQ), Journal of the Association for Information Systems (JAIS), Information Systems Journal (ISJ), European Journal of Information Systems, Journal of Strategic Information Systems, Journal of Information Technology, Decision Sciences Journal (DSJ), various IEEE Transactions, and others. He is on the senior board of editors at JMIS. He is on the senior board of editors at the JMIS. He also is an SE at ISJ and an AE at ISR. His research interests include (1) organizational and behavioral security and privacy; (2) online deviance, online harassment, and computer ethics; (3) HCI, social media, and gamification; and (4) business analytics, decision sciences, innovation, and supply chains.

Wai Fong Boh (awfboh@ntu.edu.sg) is President's Chair Professor of Information Systems at Nanyang Technological University (NTU), Nanyang Business School (NBS) in Singapore. She is Vice President for Lifelong Learning and Alumni Engagement for NTU. She is also Director of the

Information Management Research Centre at NBS, and serves as co-Director for NTU Centre in Computational Technologies for Finance. She received her PhD from the Tepper School of Business at Carnegie Mellon University. Dr. Boh's research interests lie in the areas of innovation and technology management. She has published in leading journals, including *Management Science, MIS Quarterly, Academy of Management Journal*, and others. She has served as a Senior Editor for MIS Quarterly and Associate Editor for Management Science and Information Systems Research, and sits on editorial board of several leading Information Systems journals. She holds Singapore's Public Administration Medal (Silver) and published a monograph *Identifying Business Opportunities through Innovation*. She received the AIS Fellow Award and AIS Sandra Slaughter Service Award.

Stacie Petter (petters@wfu.edu) is the inaugural Associate Provost for Faculty Affairs for Wake Forest University and the Peter C. Brockway Chair of Strategic Management and Professor of Management Information Systems at the Wake Forest University School of Business. Her research focuses on the impacts of information systems on individuals, organizations, and society, including how information technology can be used to counter human trafficking, how gamification can provide value in organizational settings, and how and why individuals use information technology for their personal or professional needs. Dr. Petter's work appears in such journals as *MIS Quarterly, Journal of Management Information Systems, Journal of the Association for Information Systems, Information Systems Journal*, and others. She has received research funding from the National Science Foundation and the IBM Center for the Business of Government. She has served in many editorial roles at journals, including Editor-in-Chief of *The DATA BASE for Advances in Information Systems*. She is a Fellow of the AIS and a recipient of the AIS Sandra Slaughter Service Award.

Jan Marco Leimeister (JanMarco.Leimeister@unisg.ch) is Chair Professor and Managing Director of the Institute of Information Systems and Digital Business at the University of St. Gallen, Switzerland. He is also Director at the Research Center for IS Design at the University of Kassel, Germany, and an AIS Fellow. His work covers digital business, AI-driven value creation, digital service management, crowdsourcing, digital Work, digital learning services, and collaboration engineering. He has been internationally recognized for out-standing research, teaching, and education. He ranks repeatedly since 2009 among the top 1% of the most productive researchers and professors in Business Administration in the German-speaking area. He has served on the AIS Leadership Council, is Co-Editor in Chief of the *Journal of Information Technology*, and serves on the Editorial Board of the *Journal of Management Information Systems* and *Information Systems Research*. Dr. Leimeister is also an entrepreneur, and acts as senior advisor, board member, and keynote speaker for national and international organizations. His research has been funded by German, Swiss, and European Union ministries as well as by industry, foundations, and NGOs.

References

1. Abbasi, A.; Parsons, J.; Pant, G.; Sheng, O.R.L.; and Sarker, S. Pathways for design research on artificial intelligence. *Information Systems Research*, *35*, 2 (2024), 441–459.
2. Ali, S.A.; and Khan, R. Metaverse marketing vs digital marketing. *International Journal of Innovative Science and Research Technology*, *8*, 1 (2023), 385–388.
3. Alimamy, S.; and Jung, T. The AR cloud: Navigating metaverse augmentation technologies for enhanced co-creation of value within services. *Journal of Service Research* 2024, in (2024), Article: 10946705241265753
4. Alsamhi, M.H.; Hawbani, A.; Kumar, S.; and Alsamhi, S.H. Multisensory metaverse-6G: A new paradigm of commerce and education. *IEEE Access*, *12*, (2024), 75657–75677.
5. Arpaci, I.; and Bahari, M. Investigating the role of psychological needs in predicting the educational sustainability of Metaverse using a deep learning-based hybrid SEM-ANN technique. *Interactive Learning Environments*, *32*, 6 (2024), 2957–2969.
6. Arya, V.; Sambyal, R.; Sharma, A.; and Dwivedi, Y.K. Brands are calling your AVATAR in Metaverse–A study to explore XR-based gamification marketing activities & consumer-based brand equity in virtual world. *Journal of Consumer Behaviour*, *23*, 2 (2024), 556–585.

7. Baía Reis, A.; and Ashmore, M. From video streaming to virtual reality worlds: An academic, reflective, and creative study on live theatre and performance in the metaverse. *International Journal of Performance Arts and Digital Media*, *18*, 1 (2022), 7–28.
8. Bansal, G.; Rajgopal, K.; Chamola, V.; Xiong, Z.; and Niyato, D. Healthcare in Metaverse: A survey on current Metaverse applications in healthcare. *IEEE Access*, *10*, (2022), 119914–119946.
9. Barrera, K.G.; and Shah, D. Marketing in the Metaverse: Conceptual understanding, framework, and research agenda. *Journal of Business Research*, *155*, Part A, January (2023), Article: 113420.
10. Biocca, F.; Owen, C.; Tang, A.; and Bohil, C. Attention issues in spatial information systems: Directing mobile users' visual attention using augmented reality. *Journal of Management Information Systems*, *23*, 4 (2007), 163–184.
11. Bohné, T.; Li, C., and Triantafyllidis, K. Exploring the industrial metaverse: A roadmap to the future. Presented at *World Economic Forum and Univesity of Cambridge*. World Economic Forum, 2023, pp. 1–19.
12. Buhalis, D.; Leung, D.; and Lin, M. Metaverse as a disruptive technology revolutionising tourism management and marketing. *Tourism Management*, *97*, August (2023), Article: 104724.
13. Camero, A.; and Alba, E. Smart City and information technology: A review. *Cities*, *93*, (2019), 84–94.
14. Cao, K.; Liu, Y.; Meng, G.; and Sun, Q. An overview on edge computing research. *IEEE Access*, *8*, (2020), 85714–85728.
15. Cavusoglu, H.; Dennis, A.R.; and Parsons, G.E.J. Special issue: Immersive systems. *Journal of Management Information Systems*, *36*, 3 (2019), 680–682.
16. Chatterjee, S.; Sarker, S.; Lee, M.J.; Xiao, X.; and Elbanna, A. A possible conceptualization of the information systems (IS) artifact: A general systems theory perspective. *Information Systems Journal*, *31*, 4 (2021), 550–578.
17. Chengoden, R.; Victor, N.; Huynh-The, T.; Yenduri, G.; Jhaveri, R.H.; Alazab, M.; Bhattacharya, S.; Hegde, P.; Maddikunta, P.K.R.; and Gadekallu, T.R. Metaverse for healthcare: A survey on potential applications, challenges and future directions. *IEEE Access*, *11*, (2023), 12765–12795.
18. Choi, D.D.; and Lowry, P.B. Balancing the commitment to the common good and the protection of personal privacy: Consumer adoption of sustainable, smart connected cars. *Information & Management*, *61*, 1 (2024), Article: 103876.
19. Chu, C-H.; Pan, J-K.; and Chen, Y-W. Ergonomic workplace design based on real-time integration between virtual and augmented realities. *Robotics and Computer-Integrated Manufacturing, 92*, April (2025), Article: 102859.
20. Cummings, J.J.; and Bailenson, J.N. How immersive is enough? A meta-analysis of the effect of immersive technology on user presence. *Media Psychology*, *19*, 2 (2016), 272–309.
21. Davis, A.; Murphy, J.; Owens, D.; Khazanchi, D.; and Zigurs, I. Avatars, people, and virtual worlds: Foundations for research in metaverses. *Journal of the Association for Information Systems*, *10*, 2 (2009), 91–117.
22. Davis, A.; Murphy, J.; Owens, D.; Khazanchi, D.; and Zigurs, I. Avatars, people, and virtual worlds: Foundations for research in metaverses. *Journal of the Association for Information Systems*, *10*, 2 (2009), 90–117.
23. Díaz Andrade, A.; Tarafdar, M.; Davison, R.M.; Hardin, A; Techatassanasoontorn, AA; Lowry, PB; Chatterjee, S; and Schwabe, G. The importance of theory at the Information Systems Journal. *Information Systems Journal*, *33*, 4 (2023), 693–702.
24. Dincelli, E.; Shekarian, N.; Zhou, X.; and Ozkaynak, M. The role of head-mounted display (HMD)-based meta-apps in advancing healthcare. In Proceedings of *57th Hawaii International Conference on System Sciences (HICSS 2024)*, 2024, pp. 4931–4940.
25. Dincelli, E.; and Yayla, A. Immersive virtual reality in the age of the Metaverse: A hybrid-narrative review based on the technology affordance perspective. *The Journal of Strategic Information Systems*, *31*, 2 (2022), Article: 101717.
26. Dolata, M.; and Schwabe, G. What is the Metaverse and who seeks to define it? Mapping the site of social construction. *Journal of Information Technology*, *38*, 3 (2023), 239–266.

27. Draper, J.V.; Kaber, D.B.; and Usher, J.M. Telepresence. *Human Factors*, *40*, 3 (1998), 354–375.
28. Dwivedi, Y.K.; Hughes, L.; Baabdullah, A.M.; Ribeiro-Navarrete, S.; Giannakis, M.; Al-Debei, M.M.; Dennehy, D.; Metri, B.; Buhalis, D.; Cheung, C.M.K.; Conboy, K.; Doyle, R.; Dubey, R.; Dutot, V.; Felix, R.; Goyal, D.P.; Gustafsson, A.; Hinsch, C.; Jebabli, I.; Janssen, M.; Kim, Y-G.; Kim, J.; Koos, S.; Kreps, D.; Kshetri, N.; Kumar, V.; Ooi, K-B.; Papagiannidis, S.; Pappas, I.O.; Polyviou, A.; Park, S-M.; Pandey, N.; Queiroz, M.M.; Raman, R.; Rauschnabel, P.A.; Shirish, A.; Sigala, M.; Spanaki, K.; Wei-Han Tan, G.; Tiwari, M.K.; Viglia, G.; and Wamba, S.F. Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, *66*, October (2022), Article: 102542.
29. Dwivedi, Y.K.; Hughes, L.; Wang, Y.; Alalwan, A.A.; Ahn, S.J.; Balakrishnan, J.; Barta, S.; Belk, R.; Buhalis, D.; and Dutot, V. Metaverse marketing: How the metaverse will shape the future of consumer research and practice. *Psychology & Marketing*, *40*, 4 (2023), 750–776.
30. Evans, L.; Frith, J., and Saker, M. Gaming worlds. In L. Evans, J. Frith, and M. Saker (eds.), *From Microverse To Metaverse: Modelling The Future Through Today's Virtual Worlds*. Emerald Publishing Limited, 2022, pp. 33–40
31. Faraboschi, P.; Frachtenberg, E.; Laplante, P.; Milojicic, D.; and Saracco, R. Virtual worlds (Metaverse): From skepticism, to fear, to immersive opportunities. *Computer*, *55*, 10 (2022), 100–106.
32. Geng, R.; Li, M.; Hu, Z.; Han, Z.; and Zheng, R. Digital Twin in smart manufacturing: Remote control and virtual machining using VR and AR technologies. *Structural and Multidisciplinary Optimization*, *65*, 11 (2022), Article: 321.
33. Getchell, K.; Oliver, I.; Miller, A., and Allison, C. Metaverses as a platform for game based learning. Presented at *2010 24th IEEE International Conference on Advanced Information Networking and Applications*. Perth, Australia: IEEE, 2010, pp. 1195–1202.
34. Gómez-Quintero, J.; Johnson, S.D.; Borrion, H.; and Lundrigan, S. A scoping study of crime facilitated by the metaverse. *Futures*, *157*, March (2024), Article: 103338.
35. Goode, S.; Shailer, G.; Wilson, M.; and Jankowski, J. Gifting and status in virtual worlds. *Journal of Management Information Systems*, *31*, 2 (2014), 171–210.
36. Gopal, A.; Chen, P-Y.; Oh, W.; Xu, S.X.; and Sarker, S. On crafting effective theoretical contributions for empirical papers in economics of information systems: Some editorial reflections. *Information Systems Research*, *35*, 3 (2024), 917–935.
37. Guo, J.; Leng, J.; Zhao, J.L.; Zhou, X.; Yuan, Y.; Lu, Y.; Mourtzis, D.; Qi, Q.; Huang, S.; Song, X.; Liu, Q.; and Wang, L. Industrial metaverse towards Industry 5.0: Connotation, architecture, enablers, and challenges. *Journal of Manufacturing Systems*, *76*, (2024), 25–42.
38. Hadi, R.; Melumad, S.; and Park, E.S. The Metaverse: A new digital frontier for consumer behavior. *Journal of Consumer Psychology*, *34*, 1 (2024), 142–166.
39. Hanneke, B.; Heß, M.; and Hinz, O. Foundations of decentralized Metaverse economies: Converging physical and virtual realities. *Journal of Management Information Systems*, *42*, 1 (2025), xx–xx.
40. Hassan, N.R.; Lowry, P.B.; and Mathiassen, L. Useful products in information systems theorizing: A discursive formation perspective. *Journal of the Association for Information Systems*, *23*, 2 (2022), 418–446.
41. Hassan, N.R.; Mathiassen, L.; and Lowry, P.B. The process of information systems theorizing as a discursive practice. *Journal of Information Technology*, *34*, 3 (2019), 198–220.
42. Kaur, J.; Mogaji, E.; Paliwal, M.; Jha, S.; Agarwal, S.; and Mogaji, S.A. Consumer behavior in the Metaverse. *Journal of Consumer Behaviour*, *23*, 4 (2024), 1720–1738.
43. Kim, N.; and Kim, W-H. The effect of meta-commerce consumption value on consumer satisfaction and continuous usage intention: The moderating roles of meta-verse involvement and consumer competency. *Asia Pacific Journal of Marketing and Logistics*, 2024, in press (2024).
44. Krüger, K.; Weking, J.; Fielt, E.; Böttcher, T.; Kowalkiewicz, M.; and Krcmar, H. Value drivers for Metaverse business models: A complementor perspective. *Journal of Management Information Systems*, *42*, 1 (2025), xx–xx.
45. Kshetri, N. The Economics of the Industrial Metaverse. *IT Professional*, *25*, 1 (2023), 84–88.

46. Kwaramba, C.S.; Goldstein, S.M.; Lowry, P.B.; Nottingham, Q.J.; and Cooper, E.F. Supply chain resilience as endotherm resilience: Theorizing through metaphorical transfer. *Production and Operations Management*, *33*, 2 (2024), 456–474.
47. Kye, B.; Han, N.; Kim, E.; Park, Y.; Jo, S.; and Huh, S. Educational applications of Metaverse: Possibilities and limitations. *Journal of Educational Evaluation for Health Professionals*, *18*, 2021 (2021), Article: 1149230.
48. Lampinen, A.; Tamminen, S., and Oulasvirta, A. All my people right here, right now: Management of group co-presence on a social networking site. Presented at *Proceedings of the 2009 ACM International Conference on Supporting Group Work*. Sanibel Island, FL: ACM, 2009, pp. 281–290
49. Lee, Y.; and Chen, A.N.K. Usability design and psychological ownership of a virtual world. *Journal of Management Information Systems*, *28*, 3 (2011), 269–308.
50. Li, Y.; Gunasekeran, D.V.; RaviChandran, N.; Tan, T.F.; Ong, J.C.L; Thirunavukarasu, AJ; Polascik, BW; Habash, R; Khaderi, K; and Ting, DSW. The next generation of healthcare ecosystem in the metaverse. *Biomedical Journal*, *47*, 3 (2024), 100679.
51. Llamas, R., and Belk, R. *The Routledge Companion to Digital Consumption* (1st ed.). New York, NY: Routledge, 2012
52. Lowry, P.B.; Boh, W.; Petter, S.; and Leimeister, J.M. Fostering the design and governance of the Metaverse: Call for submission to the special issue *Journal of Management Information Systems*, 2022, (2022), https://www.jmis-web.org/cfp
53. Lowry, P.B.; Petter, S.; and Leimeister, J.M. Desperately seeking the artefacts and the foundations of native theory in gamification research: Why information systems researchers can play a legitimate role in this discourse and how they can better contribute. *European Journal of Information Systems*, *29*, 6 (2020), 609–620.
54. Lu, S.; and Mintz, O. Marketing on the Metaverse: Research opportunities and challenges. *AMS Review*, *13*, 1 (2023), 151–166.
55. Mahmoud, A.B. The Metaverse and Web 3.0: Revolutionising consumption and communication for the future. In P. Keikhosrokiani (ed.), *Handbook of Research on Consumer Behavioral Analytics in Metaverse and the Adoption of a Virtual World*, 10.4018/978-1-6684-7029-9.ch015. Hershey, PA, USA: IGI Global, 2023, pp. 322–345.
56. Martínez-Gutiérrez, A.; Díez-González, J.; Perez, H.; and Araújo, M. Towards industry 5.0 through metaverse. *Robotics and Computer-Integrated Manufacturing, 89*, October (2024), Article: 102764.
57. Marx, J.; Mirbabaie, M.; and Rieskamp, J. Working from the Metaverse: A distraction management perspective. *Journal of Management Information Systems*, *42*, 1 (2025), xx–xx.
58. Mirza-Babaei, P.; Robinson, R.; Mandryk, R.; Pirker, J.; Kang, C., and Fletcher, A. Games and the Metaverse. Presented at *Extended Abstracts of the 2022 Annual Symposium on Computer-Human Interaction in Play*. Bremen, Germany: ACM, 2022, pp. 318–319
59. Müller, M.; Bohné, T., and Jamboula, T. Identifying key factors for the development of the Industrial Metaverse. Presented at *2023 IEEE Smart World Congress (SWC)*. Portsmouth, UK: IEEE, 2023, pp. 1–6
60. Musamih, A.; Yaqoob, I.; Salah, K.; Jayaraman, R.; Al-Hammadi, Y.; Omar, M.; and Ellahham, S. Metaverse in healthcare: Applications, challenges, and future directions. *IEEE Consumer Electronics Magazine*, *12*, 4 (2023), 33–46.
61. Nah, F.F-H.; Eschenbrenner, B.; and DeWester, D. Enhancing brand equity through flow and telepresence: A comparison of 2D and 3D virtual worlds. *MIS Quarterly*, *35*, 3 (2011), 731–747.
62. Nalbant, K.G.; and Aydın, S. Development and transformation in digital marketing and branding with artificial intelligence and digital technologies dynamics in the Metaverse universe. *Journal of Metaverse*, *3*, 1 (2023), 9–18.
63. Nateghi, A.; and Mosharraf, M. Architecting the future: A model for enterprise integration in the Metaverse. *Journal of Metaverse*, *3*, 2 (2023), 190–199.
64. Neves, J.R.; and Bacalhau, L.M. Dive into Metaverse: Concept, evolution, framework, technologies, opportunities, and trends. In J. Kumar, M. Arora, and G.E. Bayram (eds.), *Research,*

Innovation, and Industry Impacts of the Metaverse, 10.4018/979-8-3693-2607-7.ch001. Hershey, PA: IGI Global, 2024, pp. 1–26.
65. Newell, S. Everything you always wanted to know about the metaverse*(* But were afraid to ask). Presented at *Academy of Management Annual Meeting*, 2022
66. Oh, H.J.; Kim, J.; Chang, J.J.C.; Park, N.; and Lee, S. Social benefits of living in the metaverse: The relationships among social presence, supportive interaction, social self-efficacy, and feelings of loneliness. *Computers in Human Behavior*, *139*, (2023), 107498.
67. Pacchierotti, C.; Chinello, F.; Koumaditis, K.; Di Luca, M.; Ofek, E., and Georgiou, O. Haptics in the Metaverse: Haptic feedback for virtual, augmented, mixed, and eXtended realities. *IEEE Transactions on Haptics (ToH)*, *17*, 2 (2024), 122–128.
68. Park, S.; and Kim, J. Fear of sexual victimization in Metaverse: A comparison of adolescent and adult female users. *Cyberpsychology, Behavior, and Social Networking*, *27*, 7 (2024), 490–497.
69. Park, S.M.; and Kim, Y.G. A metaverse: Taxonomy, components, applications, and open challenges. *IEEE Access*, *10*, (2022), 4209–4251.
70. Peukert, C.; Pfeiffer, J.; Meißner, M.; Pfeiffer, T.; and Weinhardt, C. Shopping in virtual reality stores: The influence of immersion on system adoption. *Journal of Management Information Systems*, *36*, 3 (2019), 755–788.
71. Putzke, J.; Fischbach, K.; Schoder, D.; and Gloor, P.A. The evolution of interaction networks in massively multiplayer online games. *Journal of the Association for Information Systems*, *11*, 2 (2010), 69–94.
72. Risteska Stojkoska, B.L.; and Trivodaliev, KV. A review of Internet of Things for smart home: Challenges and solutions. *Journal of Cleaner Production*, *140*, (2017), 1454–1464.
73. Saffari, F.; Kakaria, S.; Bigné, E.; Bruni, L.E.; Zarei, S.; and Ramsøy, T.Z. Motivation in the metaverse: A dual-process approach to consumer choices in a virtual reality supermarket. *Frontiers in Neuroscience, 17*, February (2023), Article: 1062980.
74. Sakamoto, D.; and Ono, T. Metaverse technologies can foster an inclusive society. *Nature Human Behaviour*, *8*, 10 (2024), 1827–1828.
75. Schöbel, S.M.; and Leimeister, JM. Metaverse platform ecosystems. *Electronic Markets*, 33, 1 (2023), 12.
76. Shardeo, V.; Sarkar, B.D.; Mir, U.B.; and Kaushik, P. Adoption of Metaverse in healthcare sector: An empirical analysis of its enablers. *IEEE Transactions on Engineering Management*, *71*, (2024), 8671–8685.
77. Shen, B.; Tan, W.; Guo, J.; Zhao, L.; and Qin, P. How to promote user purchase in metaverse? A systematic literature review on consumer behavior research and virtual commerce application design. *Applied Sciences*, *11*, 23 (2021), Article: 11087.
78. Shin, D. The actualization of meta affordances: Conceptualizing affordance actualization in the metaverse games. *Computers in Human Behavior*, *133*, (2022), 107292.
79. Steffen, J.H.; Gaskin, J.E.; Meservy, T.O.; Jenkins, J.L.; and Wolman, I. Framework of affordances for virtual reality and augmented reality. *Journal of Management Information Systems*, *36*, 3 (2019), 683–729.
80. Sung, E.; Kwon, O.; and Sohn, K. NFT luxury brand marketing in the metaverse: Leveraging blockchain-certified NFTs to drive consumer behavior. *Psychology & Marketing*, *40*, 11 (2023), 2306–2325.
81. Tang, F.; Chen, X.; Zhao, M.; and Kato, N. The Roadmap of Communication and Networking in 6G for the Metaverse. *IEEE Wireless Communications*, *30*, 4 (2022), 72–81.
82. Turan Akdag, M., and Wahl, N. Behind the veil: Exploring anonymity's effect in emerging Metaverse for mental health therapy. In Proceedings of *57th Hawaii International Conference on System Sciences (HICSS 2024)*. Oʻahu, HI: IEE, 2024, pp. 1456–1465
83. Ullah, H.; Manickam, S.; Obaidat, M.; Laghari, S.U.A.; and Uddin, M. Exploring the potential of metaverse technology in healthcare: Applications, challenges, and future directions. *IEEE Access*, *11*, (2023), 69686–69707.
84. Wang, G.; Zhang, Z.; Nandhakumar, J.; and Manoharan, N. Everyday Metaverse: The Metaverse as an integral part of everyday life. *Journal of Management Information Systems*, *42*, 1 (2025), xx–xx.

85. Wang, L.; Lowry, P.B.; Luo, X., and Li, H. Moving consumers from free to fee in platform-based markets: An empirical study of multiplayer online battle arena games. *Information Systems Research*, *34*, 1 (2023), 275–296.
86. Wanick, V., and Stallwood, J. Brand storytelling, gamification and social media marketing in the "Metaverse": A case study of the Ralph Lauren winter escape. In E. Bazaki, and V. Wanick (eds.), *Reinventing Fashion Retailing: Digitalising, Gamifying, Entrepreneuring*. Cham, Switzerland: Springer, 2023, pp. 35–54
87. Westmattelmann, D.; Stoffers, B.; Märtins, J.; and Xiao, X. Exploring the new playing field: The input-output principle of meta-sports *Journal of Management Information Systems*, *42*, 1 (2025), xx–xx.
88. Wosik, J.; Fudim, M.; Cameron, B.; Gellad, Z.F.; Cho, A.; Phinney, D.; Curtis, S.; Roman, M.; Poon, E.G.; Ferranti, J.; Katz, J.N.; and Tcheng, J. Telehealth transformation: COVID-19 and the rise of virtual care. *Journal of the American Medical Informatics Association*, *27*, 6 (2020), 957–962.
89. Xi, N.; Chen, J.; Gama, F.; Riar, M.; and Hamari, J. The challenges of entering the metaverse: An experiment on the effect of extended reality on workload. *Information Systems Frontiers*, *25*, February (2023), 659–680.
90. Xiong, B.; Fang, J., and Li, W. Beyond the screen: How the Metaverse is reshaping multichannel retail through XR adoption and the delicate balance between complementarity and substitution, *Journal of Management Information Systems*, *42*, 1 (2025), xx–xx.
91. Yang, F.X., and Wang, Y. Rethinking Metaverse tourism: A taxonomy and an agenda for future research. *Journal of Hospitality & Tourism Research*, *49*, 1 (2025), 3–12.
92. Yang, Y.; Siau, K.; Xie, W.; and Sun, Y. Smart health: Intelligent healthcare systems in the Metaverse, artificial intelligence, and data science era. *Journal of Organizational and End User Computing (JOEUC)*, *34*, 1 (2022), 1–14.
93. Yao, X.; Ma, N.; Zhang, J.; Wang, K.; Yang, E.; and Faccio, M. Enhancing wisdom manufacturing as industrial metaverse for industry and society 5.0. *Journal of Intelligent Manufacturing*, *35*, 1 (2024), 235–255.
94. Yee, N.; and Bailenson, J. The Proteus effect: The effect of transformed self-representation on behavior. *Human Communication Research*, *33*, 3 (2007), 271–290.
95. Yoo, K.; Welden, R.; Hewett, K.; and Haenlein, M. The merchants of meta: A research agenda to understand the future of retailing in the metaverse. *Journal of Retailing*, *99*, 2 (2023), 173–192.
96. Yu, J.; Alhilal, A.; Hui, P.; and Tsang, D.H.K. Bi-directional digital twin and edge computing in the Metaverse. *IEEE Internet of Things Magazine*, *7*, 3 (2024), 106–112.
97. Zahedi, F.M.; Walia, N.; and Jain, H. Augmented virtual doctor office: Theory-based design and assessment. *Journal of Management Information Systems*, *33*, 3 (2016), 776–808.
98. Zhang, S.; Li, J.; Shi, L.; Ding, M.; Nguyen, D.C.; Chen, W.; and Han, Z. Industrial Metaverse: Enabling technologies, open problems, and future trends. *arXiv*, *2014*, (2024), article: arXiv:2405.08542.
99. Zhang, Z.; Guo, X.; and Lee, C. Advances in olfactory augmented virtual reality towards future metaverse applications. *Nature Communications*, *15*, 1 (2024), Article: 6465.
100. Zhou, Z.; Chen, Z.; Li, W.; Zhang, Y.; and Jin, X-L. Demystifying the dimensions and roles of Metaverse gaming experience value: A multi-study investigation. *Journal of Management Information Systems*, *42*, 1 (2025), xx–xx.
101. Zierau, N.; Hildebrand, C.; Bergner, A.; Busquet, F.; Schmitt, A.; and Marco Leimeister, J. Voice bots on the frontline: Voice-based interfaces enhance flow-like consumer experiences & boost service outcomes. *Journal of the Academy of Marketing Science*, *51*, 4 (2023), 823–842.