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If you have any questions, want to request a copy of the final version of the article, or would like copies of other articles we've published, please contact any of us directly as follows:

- **Prof. Paul Benjamin Lowry**
  - Pamplin College of Business, Virginia Tech, Blacksburg, USA
  - Website: https://sites.google.com/site/professorlowrypaulbenjamin/home
  - System to request Paul's articles:https://seanacademic.qualtrics.com/SE/?SID=SV_7WCaP0V7FA0GWWx
  - E-mail: Paul.Lowry.PhD@gmail.com
- **Prof. Waifong Boh**
  - Nanyang Business School, Nanyang Technological University, Singapore
  - Website: https://www3.ntu.edu.sg/home/awfboh/index.htm
  - E-mail: awfboh@ntu.edu.sg
- **Prof. Stacie Petter**
  - Wake Forest University School of Business
  - Website: https://petters.sites.wfu.edu/
  - E-mail: petters@wfu.edu
- **Prof. Jan Marco Leimeister**
  - University of St.Gallen (HSG)
  - Institute for Information Systems and Digital Business (IWI HSG)
  - Website: https://cas-bdai.iwi.unisg.ch/main-lecturer/prof-dr-jan-marco-leimeister/
  - E-mail: JanMarco.Leimeister@unisg.ch

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

Paul Benjamin Lowry[a], Waifong Boh[b], Stacie Petter[c], and Jan Marco Leimeister[d]

[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

Prof. Paul Benjamin Lowry, Ph.D., is an Eminent Scholar and the Suzanne Parker Thornhill Chair Professor in Business Information Technology at the Pamplin College of Business at Virginia Tech, where he serves as the BIT Ph.D. and Graduate Programs Director. 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 270+ publications, including 150+ 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 a Department Editor at DSJ. He is on the senior board of editors at JMIS. He is also an SE at JAIS and 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.

Business Information Technology
Pamplin College of Business
Virginia Tech
Pamplin Hall, Suite 1007
880 West Campus Drive
Blacksburg, VA 24061 USA
Office Phone: +1 (540) 231-9128
Email: Paul.Lowry.PhD@gmail.com

Waifong Boh, Ph.D., is President's Chair Professor of Information Systems at Nanyang Technological University (NTU), Nanyang Business School (NBS) in Singapore. She is currently Vice President for Lifelong Learning and Alumni Engagement for NTU. She is also Director of Information Management Research Centre at NBS, and she serves as co-Director for NTU Centre in Computational Technologies for Finance (CCTF). She received her PhD from the Tepper School of Business at Carnegie Mellon University. Her research interests are in the areas of innovation and technology management. She has published in leading journals, including Management Science, MIS Quarterly, Academy of Management Journal, etc. She is currently Senior Editor of MIS Quarterly, and has been previously AE for Management Science and ISR. Further, she is currently on or had been previously on the editorial board of multiple leading Information Systems journals. She was recently awarded Singapore's Public Administration Medal (Silver) and published a book on Identifying Business Opportunities through Innovation. In 2023, she received the AIS Fellow Award and the AIS Sandra Slaughter Service Award.

Nanyang Business School

Nanyang Technological University
91 Nanyang Avenue, Gaia, ABS-06-131
Singapore 639956
Office Phone: +65 6790 6196
Email: awfboh@ntu.edu.sg

Stacie Petter, Ph.D., 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. Much of 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. Her work appears in outlets such as *MIS Quarterly*, *Journal of Management Information Systems*, *Journal of the Association for Information Systems, Information Systems Journal,* and other scholarly outlets. She has received funding for her research from the National Science Foundation and the IBM Center for the Business of Government. She has served in many editorial roles for journals, including Editor-in-Chief of *The DATA BASE for Advances in Information Systems.* Petter is a Fellow of the Association for Information Systems and a recipient of the Association for Information Systems Sandra Slaughter Service Award.

Wake Forest University
PO Box 7688
Winston-Salem, NC 27109
Office Phone: 336-758-3766
Email: petters@wfu.edu

Jan Marco Leimeister, PhD, is Chair Professor and Managing Director of the Institute of Information Systems and Digital Business at the University of St.Gallen, Switzerland. He is furthermore a Director at the Research Center for IS Design at the University of Kassel, Germany. His work covers Digital Business, Digital Transformation, Digital Service Management, Crowdsourcing, Digital Work, Digital Learning Services and Collaboration Engineering. Jan Marco 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 as VP Education, is Co-Editor in Chief of the *Journal of Information Technology (JIT)* and serves on the Editorial Board of the *Journal of Management Information Systems (JMIS)* and *Information Systems Research (ISR)*. He is also an Entrepreneur and works 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 from industry, foundations, and NGOs.

University of St.Gallen (HSG)
Institute for Information Systems and Digital Business (IWI HSG)
Müller-Friedberg-Strasse 8
9000 St.Gallen
Switzerland
Office Phone: +41 71 224 3330
Email: JanMarco.Leimeister@unisg.ch

Long Live the Metaverse: Identifying Possibilities for Market Disruptions and Future Research

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 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 (VR), mixed reality (MR), augmented reality (AR), extended reality (XR), artificial intelligence (AI), immersion

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." 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, 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.

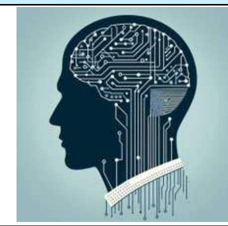
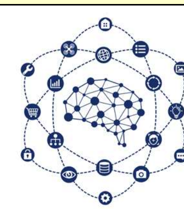
IS scholars have studied virtual worlds for decades [e.g., 21, 49], and virtual worlds are foundational to the Metaverse. Although a given Metaverse typically involves a virtual world, not every virtual world is a metaverse. Nevertheless, a Metaverse evolves as users interact with the virtual world and 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 IoT, AI/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

Figure 1. Taxonomy of Three Tiers of Enabling Technologies for the Emergent Metaverse

Tier 3: Technologies that Foster Virtual–to-Physical Connectivity for the Metaverse			
Facilitators of HCI	**Facilitators of perception and sensing**	**Robotics and automation**	**Connected smart systems**
			
Haptic devices, goggles/glasses, voice recognition, eye tracking	Computer vision, facial recognition, autonomous systems, sensors	Robotics, digital manufacturing, sensors, IoT, dynamic systems	Smart vehicles, smart devices, smart homes, smart cities
Tier 2: Foundational Technology Enablers of the Metaverse			
Immersive technologies	**Digital representations and assets**	**Blockchain & decentralized Systems**	**AI & computational models**
			
AR, MR, VR, XR	Digital twins, avatars, digital humans, 2D & 3D digital assets	Blockchain, NFTs, cryptocurrencies	AI, DL, ML, NLP
Tier 1: Communication and Infrastructure Technologies of the Metaverse			
Cloud computing	**Edge computing**	**5G and 6G wireless**	**Advanced networks**
			
Public, private, hybrid, and community clouds	IoT, AI/ML, content delivery, industrial, retail, healthcare, smart city, and automotive edges	Terahertz band communication, AI-driven wireless, quantum communication	Web 3.0, Quantum networks, space-based communication, block-chain enabled networks

experience the Metaverse using 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:

(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. *Extended reality* (XR) includes various forms of multimodal virtual-to-physical realism—the blending of virtual and physical worlds—and typically leverages virtual reality (VR), augmented reality (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 machine learning (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 Internet of Things (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 (B2B vs. 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] Nonfungible tokens (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 Internet of Things (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].

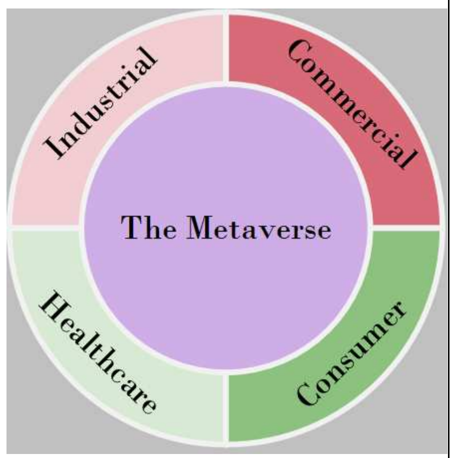
Moving Toward Intersectional Opportunities

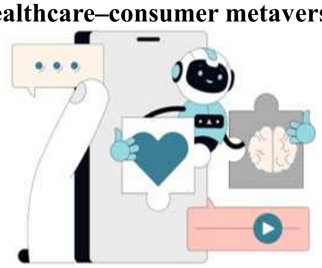
Summarizing our review, our operating premise is that these four markets naturally will evolve out of their current physical and e-commerce manifestations, such that the initial business models will be generally expected. However, we envision that the more compelling research and business model opportunities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

Figure 2. Intersectional Research and Business Opportunities in the Four Major Metaverse Markets

<table>
<tr>
<td>Industrial metaverses
</td>
<td>Industrial–commercial metaverses

digital twins for SCM, virtual product design, immersive retail supply chain optimization, smart warehousing & distribution centers, virtual trade shows & B2B marketplaces</td>
<td>Commercial metaverses
</td>
</tr>
<tr>
<td>Industrial–healthcare metaverses

Immersive surgical training, virtual medical equipment training, digital twins for patient care and facility management, collaborative R&D, remote maintenance and support for medical devices</td>
<td>
</td>
<td>Commercial–consumer metaverses

Immersive e-commerce platforms, direct-to-avatar (D2A) commerce, virtual real estate and interior design, live shopping and social commerce, event-based marketing, and pop-up stores.</td>
</tr>
<tr>
<td>Healthcare metaverses
</td>
<td>Healthcare–consumer metaverses

Virtual fitness and training, mental health and meditation platforms, telemedicine in immersive clinics, personalized health marketplaces</td>
<td>Consumer metaverses
</td>
</tr>
</table>

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 MG 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 Table A.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 Table A.3.

The 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 Table A.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 Table A.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 Table A.6.

The 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 Table A.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 Table A.8.

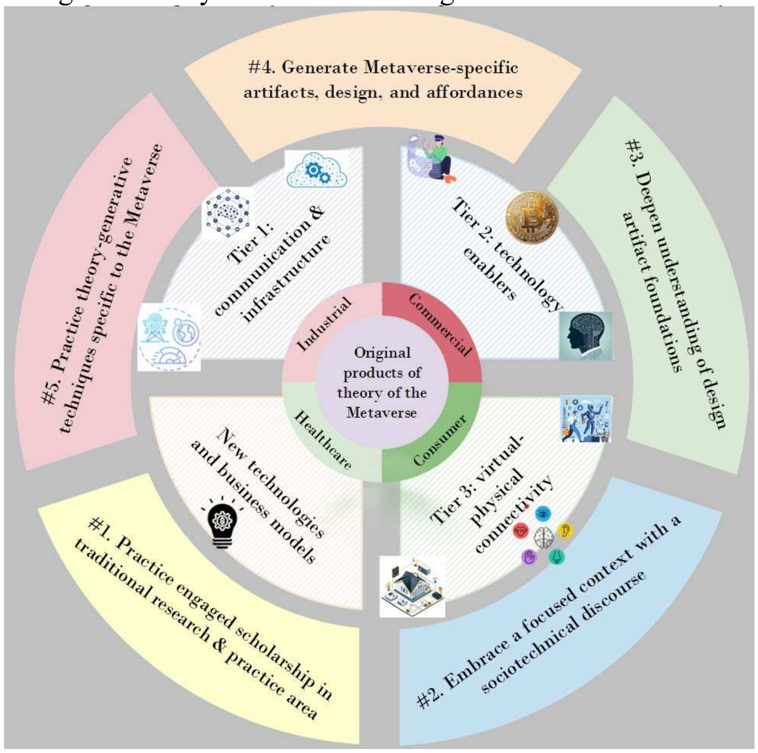
Expanding Horizons: Research Directions in Understanding the Metaverse

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.

#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

Figure 3. Design Thinking and Theory Generation for Original Metaverse Products of Theory



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, [100] shows 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.

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

Appendix A. Supplementary Support Materials

Table A.1. Overview of Articles Selected for the Special Issue on the Metaverse

Citation, Title	General Approach	Theoretical, Research, and Theory Contributions	Implications for Practice, Design, and Policy
Hanneke et al. [1] Foundations of decentralized Metaverse economies: Converging physical and virtual realities	• Defines blockchain-based metaverses and decentralized Metaverse economies • Explores the merging of scarcity and ownership from real economies with the digital aspects of virtual economies • Hypothesizes relationships between exchange rates and key economic variables (e.g., actors, transactions, asset creations) • Analyzes 4.5 million transactions from Ethereum and Polygon blockchains within "The Sandbox" Metaverse • Estimates a vector autoregressive (VAR) model to examine dynamics between exchange rates and economic activity • Validates empirical findings through additional robustness checks	• New conceptual framework for understanding decentralized Metaverse economies • Integrates principles from real, virtual, and blockchain economic systems • Clarifies blockchain's role in enabling decentralized digital ownership and scarcity • Highlights shift from centralized to decentralized control in virtual economies • Empirical insights into exchange rates and economic activity relationships • Finds higher exchange rates correlate with more economic activity and actor participation • Identifies trade-offs with higher exchange rates, including potential barriers to entry	• Offers insights for designing stable, decentralized economies • Provides tools to create growth-focused policies while addressing risks • Enhances understanding of how decentralized economies connect to real, virtual, and blockchain economies • Establishes directions for exploring the convergence of economic systems in decentralized virtual environments
Krüger et al. [2] Value drivers for Metaverse business models: A complementor perspective	• **Multiple Case Studies**: Analysis of 29 firms acting as complementors within the Metaverse ecosystem • Firms represent diverse industries offering complementary products and services in virtual environments	• Empirical evidence from 29 complementor firms on leveraging Metaverse for value creation • Practical framework for firms adapting business models to the Metaverse Five critical Metaverse-enabled value drivers for complementors:	• Insights into strategic value generation sources and differentiation in the Metaverse • Encourages using Metaverse-specific value drivers to transform business frameworks • Leverages Metaverse opportunities to deepen

Citation, Title	General Approach	Theoretical, Research, and Theory Contributions	Implications for Practice, Design, and Policy
		• **Immersive customer engagement**: Engaging, interactive virtual experiences for customers • **Massively scaled user innovation**: Harnessing user creativity for product innovation • **Virtual business efficiency**: Enhancing operational efficiency, reducing physical infrastructure costs • **Digital exclusivity**: Offering unique, non-duplicable products, such as NFTs • **Extended ecosystem collaboration**: Enabling value co-creation through cross-platform partnerships	customer interactions and engagement • Advises on establishing revenue sources within the Metaverse • Highlights the importance of creating unique virtual models rather than duplicating physical ones • Suggests leveraging virtual economies and digital ownership for innovative business practices
Marx et al. [3] Working from the Metaverse: A distraction management perspective	• Two-Phase Qualitative Study: Conducted with 32 knowledge workers to explore distraction management in VR-based Metaverse • **Phase 1**: Intervention where participants performed solo work tasks in an immersive virtual environment • **Phase 2**: In-depth interviews to examine participants' distraction management experiences • **Grounded theory development**: Analyzed data to develop new theoretical concepts • **Distraction shielding**: Proactively shaping the virtual environment to minimize distractions • **Arousal filtering**: Cognitive processing and response to potential distractions in	• Introduces a solo work perspective for Metaverse applications • Challenges focus on replicating traditional corporate offices for collaboration • Concepts of distraction shielding and arousal filtering offer new insights into enhancing solo work outcomes • Empirical evidence that Metaverse applications aid distraction management during solo work • Contradicts the assumption that Metaverse use is primarily for collaboration • Demonstrates the versatility of	• Guides effective design and use in work settings • Recommends focusing on features that enhance productivity for individual tasks • Advises against recreating traditional office spaces in the virtual environment • Encourages designs that use the Metaverse's immersive potential to boost focus and minimize distractions

Citation, Title	General Approach	Theoretical, Research, and Theory Contributions	Implications for Practice, Design, and Policy
	the virtual space • Proposes a virtual workplace distraction management model combining distraction shielding and arousal filtering	immersive environments for various work types, including solo tasks	
Wang et al. [4] everyday Metaverse: The Metaverse as an integral part of everyday life	• **Interpretive case study**: Examined the design process of a hybrid city project integrating Metaverse tech into urban residents' daily lives • Rigorous analysis revealed two fundamental design mechanisms for the everyday Metaverse • Designing digital spaces that mirror physical entities and real-time events, such as virtual versions of bars or clubs • Ensuring digital content is contextually relevant to users' current activities for practical, real-world application • Proposed a framework for integrating Metaverse into daily life, highlighting seamless transitions between digital and physical worlds	• Introduces the "everyday Metaverse" as a new paradigm • Shifts from viewing the Metaverse as a separate, immersive digital world to an integrated digital-physical space • Expands theoretical understanding of seamless digital and physical world integration • Foundation for future research on interactive, adaptable digital environments that enhance real-life activities • Case study of a hybrid city project offers empirical insights on everyday Metaverse design • Emphasizes including physical entities in digital spaces for relevance to real-world contexts • Practical guidance for designers on making the Metaverse relevant to daily life	• Offers insights for designers and companies on blending Metaverse technologies into daily life • Identifies fundamental mechanisms for smooth transitions between digital and physical worlds • Encourages designs that prevent disruption and foster connection to real-life contexts • Recommends creating user-friendly, flexible spaces that align with everyday activities • Advocates for digital products that naturally integrate with physical interactions • Supports a design approach that emphasizes harmony between digital and physical experiences
Westmattelmann et al. [5] Exploring the new playing field: The input-output principle of meta-sports	• **Comparative mixed-methods study**: Conducted on the German Virtual Cycling Bundesliga (GVCB) on Zwift, covering data from 2020 and 2021 competitions • **Objective data**: Collected performance inputs and competition results from the platform • **Survey data**: Gathered athlete feedback on competition perceptions and the	• Establishes a theoretical foundation for meta-sports using distributive justice in virtual sports • Contextualizes transparency as crucial for athletes' fairness perceptions • Fills literature gap on fairness and transparency in algorithm-driven meta-sports results	• Offers design guidelines to enhance meta-sports and similar Metaverse applications • Focus on transparency: Stresses clear communication of how performance data influences competition outcomes • Build athlete trust: Ensures transparency to uphold

Citation, Title	General Approach	Theoretical, Research, and Theory Contributions	Implications for Practice, Design, and Policy
	input-output system • **Interview data**: In-depth interviews to examine athletes' experiences and perceptions of fairness	• **Transparency gap**: Identifies gap where athletes' data doesn't fully explain competition outcomes, impacting fairness perceptions • **Dynamic information needs**: Athletes' information needs shift from accuracy to clarity as they gain platform experience • **perceived fairness and participation**: fairness perceptions affect ongoing participation, mediated by the perceived relevance of competition • Empirical evidence from Zwift's GVCB platform shows evolving fairness perceptions with platform familiarity • Highlights the need for clear, timely input-output information to maintain athlete trust	athletes' confidence in the fairness of virtual competitions • Encourage long-term engagement: Supports sustained athlete participation through fair and transparent systems
Xiong et al. [6] Beyond the screen: How the Metaverse is reshaping multichannel retail through XR adoption and the delicate balance between complementarity and substitution	• Analysis of 667 multichannel retailers with 11,643 monthly observations (2019-2022), tracking XR adoption, offline store features, and online traffic • Uses staggered difference-in-differences (DiD) models to assess the causal effects of XR adoption on offline performance over time • Differentiates between distinct impacts enhancement XR (augmenting physical interactions) and creation XR (simulating virtual experiences) to examine offline transactions • Explores how regional store density influences the XR adoption effect on	• Introduces a time-varying perspective on XR adoption in multichannel retailing within the Metaverse • Challenges the traditional static view of XR effects on offline stores, showing evolving impacts • Differentiates enhancement XR from creation XR, refining the theoretical understanding of XR in retail • Empirical evidence from a large dataset tracking online and offline retail activity at a microeconomic level	• Guidance on optimizing channel structures in the Metaverse era • Emphasizes careful selection of XR type and consideration of store density to balance cross-channel effects • Advises staggered rollout of XR as its impact on offline transactions may lessen over time • Provides insights for policymakers on regulating XR technology in retail • Supports policies encouraging

Citation, Title	General Approach	Theoretical, Research, and Theory Contributions	Implications for Practice, Design, and Policy
	offline performance, potentially reducing substitution by lowering online-to-offline switching costs	• Findings show an initial boost in offline transactions due to increased brand visibility from XR • Over time, XR's novelty declines, leading to a potential substitution effect favoring online channels • Impact moderated by XR type (enhancement vs. creation) and offline store density	tech innovation while managing potential impacts on physical retail
Zhou et al. [7] Demystifying the dimensions and roles of Metaverse gaming experience value: A multi-study investigation	• Multi-study approach: Combined qualitative coding, machine learning, and econometric analysis to examine MGEV dimensions in Metaverse gaming (MG) • Qualitative coding: Manually coded online reviews, identifying six main MGEV dimensions and 21 sub-dimensions specific to MG • Created a two-axis framework based on intrinsic/extrinsic and active/reactive perspectives to categorize MGEV • Deep learning model: Developed a model using 7,751 reviews from 75 MG providers to automate MGEV labeling, creating a balanced dataset • Econometric analysis: Validated the typology by examining MGEV dimensions' impact on word of mouth (WOM) to establish nomological validity • Cluster analysis: Identified three distinct player groups with unique MGEV profiles, showing varied participation and WOM patterns	• Introduces a context-specific typology of Metaverse gaming experience value (MGEV) • Integrates motivation-based and activeness-based perspectives for a nuanced view of experience value • Extends gaming literature by capturing the unique dynamics of Metaverse gaming across digital and physical realms • Empirical evidence on MGEV dimensions and their influence on player behavior and word-of-mouth (WOM) • Uses a deep learning model to analyze player reviews, showing MGEV's impact on engagement and platform promotion • Highlights diverse player profiles with distinct MGEV priorities through a player-centered approach	• Provides actionable design guidance for platform development • Enables developers to design experiences based on specific MGEV dimensions, enhancing engagement and satisfaction • Identifies unique MGEV profiles, aiding in targeted personalization and user segmentation • Supports strategies for segmenting and catering to a diverse and broader player base

Table A.2. Additional Research Opportunities Fostered by Zhou et al. [7]

Opportunity	**Specific Examples**
Conduct cross-cultural studies	• Given that, future research could examine MGEV dimensions and typologies across various cultural contexts. • Exploring cultural and geographic differences could illuminate how intrinsic and extrinsic value dimensions vary across player populations. It could help identify potential universal and culture-specific dimensions in MGEV, contributing to a more globalized MGEV framework.
Engage in longitudinal studies	• A longitudinal study could reveal how player preferences in MGEV dimensions evolve with technological changes, game genres, and social influences. • A longitudinal approach could shed light on temporal shifts in the significance of specific MGEV dimensions, potentially indicating how the same player profiles (e.g., intrinsic or extrinsic value-dominated) adapt their expectations and behaviors over time.
Expand to more emerging advanced technologies	• The role of advanced technologies such as VR, AR, and haptic feedback within the MGEV framework warrants further exploration. • Research could examine how integrating these technologies transforms the importance of intrinsic dimensions like immersive sensory appeal or extrinsic dimensions such as device usability and ephemeral value. • The intersection of immersive technology and activeness-focused interactions within the MGEV framework is essential to examine.
Expand dependent variable beyond word-of-mouth (WOM)	• Other behavioral and attitudinal outcomes, such as player retention, brand loyalty, and engagement intensity, could provide a more comprehensive view of MGEV's impact. • This expanded focus could enhance the predictive validity of MGEV frameworks and allow for constructing models that link MGEV profiles to broader engagement metrics across various gaming contexts.
Expand to gamification and beyond	• Given the emergence of "gamification" in fields like education, fitness, and workplace productivity, there is an opportunity to test the MGEV framework in these non-gaming environments. • Future studies could examine whether MGEV dimensions (e.g., immersive appeal, device usability) translate to these contexts and determine if additional dimensions unique to non-gaming experiences emerge, potentially leading to a broadened MGEV framework that applies across various digital experiences.
Unveil implications for social media	• Exploring the impact of social media and peer interactions on MGEV adoption could uncover how user-generated content, reviews, and social sharing affect WOM dynamics for different MGEV dimensions. • Research could explore how social media visibility impacts specific MGEV dimensions and subsequently affects player behavior, such as the likelihood of returning to the game or recommending it to others.

Table A.3. Additional Research Opportunities Fostered by Westmattelmann et al. [5]

Opportunity	**Specific Examples**
Examine further impact of the transparency gap	• Research could explore how athletes' understanding (or lack thereof) of it affects their motivation and trust in meta-sports platforms. • Studying the psychological implications of this gap could reveal how perceptions of fairness and unpredictability influence immediate engagement and long-term commitment to meta-sports, adding depth to our understanding of athlete engagement.
Study justice in other contexts	• Research could expand this work to team-based or strength-oriented sports to examine whether distributive justice perceptions and transparency needs differ by sport type. • Understanding how these perceptions vary could help tailor algorithmic fairness principles to different sports contexts within the Metaverse. • This can also be useful to expand into team-based gaming and gamification studies. • With advancements toward fully immersive Metaverse platforms, future studies could examine how higher levels of immersion (e.g., VR, haptic feedback) influence perceptions of distributive justice and transparency requirements. • Increased immersion may enhance or mitigate the importance of algorithmic transparency, influencing whether fairness concerns become more or less critical as experiences become more life-like.
Expand to spectators	• Research could explore spectators' social and psychological experiences in meta-sports, especially in mixed-reality settings. • Examining how transparency and algorithmic fairness impact spectators' perceptions of competition legitimacy and entertainment value could be invaluable, particularly as the spectator experience will shape the broader appeal and economic viability of meta-sports.
Consider algorithmic fairness	• Research could study how ethical transparency frameworks (e.g., fairness auditing and interpretability) could be applied to algorithms governing competition outcomes, significantly when unknown factors influence these outcomes. • Ethical research could inform regulatory frameworks for the governance of fairness in meta-sports and, again, similar team-based contexts in gaming and gamification.
Expand to tokenized rewards	• With growing interest in digital assets and tokenization, future research could examine how tokenized rewards impact athlete motivation and perceptions of fairness. • Research could assess whether the distribution of digital assets aligns with athletes' performance or engagement and how this economic element influences the attractiveness and sustainability of meta-sports. • This is also a compelling area for experimental economics to engage, given their role in understanding economic incentives' positive and negative consequences.
Expand to the physical world	• Studies could explore the potential of meta-sports platforms as training tools for real-world sports, analyzing how transparency in data feedback influences training outcomes. • This could involve comparing performance gains between athletes training in virtual versus physical settings, focusing on how accurately the platform simulates real-world training environments and the perceived value of these tools for professional athletes.

Table A.4. Additional Research Opportunities Fostered by Wang et al. [4]

Opportunity	**Specific Examples**
Explore the role of adaptive user interfaces and the design of digital twins	• Because seamless transitions and intuitive interactions are pivotal, future research could examine the development and user impact of adaptive interfaces that dynamically respond to context (e.g., location, activity, mood). • Can investigate how interface designs can autonomously adjust based on situational cues, which may reveal valuable insights into creating Metaverse experiences that feel more natural and unobtrusive in everyday life. • As interactions become more intuitive and unconscious, research could examine how traditional engagement theories adapt to these new, less deliberate interactions. • Studies might analyze how user engagement differs when interactions are more subtle or subconscious and develop new frameworks to gauge engagement, potentially refining models like technology acceptance for the everyday Metaverse. • Research could examine how attentive association informs the development of digital twins—virtual replicas of physical environments—in the everyday Metaverse. • Research could explore how digital twins designed with life relevance affect user engagement and productivity, primarily when used to enhance or extend real-world activities.
Promote research on user-driven mechanisms for boundary control and moving between environments	• Given the potential for continuous connectivity to blur work-life boundaries, research could focus on user-driven boundary management mechanisms. • Studies might investigate tools that allow users to define and enforce digital boundaries (e.g., selective notifications, scheduled downtime) and assess how these tools affect user autonomy and digital well-being in the everyday Metaverse. • Research could investigate the technical challenges and benefits of cross-device interoperability within the everyday Metaverse. Studies could explore how seamlessly switching between devices (e.g., phones, smart home interfaces, wearable tech) impacts user experience, examining the role of device-agnostic designs that enable users to transition between digital and physical environments effortlessly.
Assess personal and social impacts	• Research could investigate the psychological implications of an everyday integrated Metaverse, such as shifts in reality perception, mental well-being, and social relationships. • Studies could track how continuous engagement with digital elements affects mental health and explore potential strategies for mitigating risks like digital fatigue or dependency on virtual interactions. • Because the everyday Metaverse aims for seamless transitions, future research could explore how synchronizing digital and physical experiences affects productivity, time management, and the overall flow of daily life. • Longitudinal studies could examine how this synchronization impacts users' ability to switch between tasks smoothly or affects perceived time efficiency in work and personal contexts.
Assess governance, ethics, and sustainability issues	• Given the vast amounts of sensitive data generated in a highly integrated Metaverse, future studies could explore governance frameworks that address privacy, security, and ethical data use. • Research could analyze the effectiveness of decentralized data control mechanisms (e.g., blockchain-based privacy protocols) and user-driven data management to ensure privacy and transparency in continuously connected environments. • The constant digital presence of the everyday Metaverse could have ecological implications. Research could investigate the energy demands of maintaining an always-on infrastructure, studying whether renewable energy integration and eco-conscious design can make the Metaverse sustainable. • Studies might also explore ethical concerns, such as reducing digital waste and ensuring equitable access.

Table A.5. Additional Research Opportunities Fostered by Westmattelmann et al. [5]

Opportunity	**Specific Examples**
Expand the scope of ecosystems	• Given the ecosystem emphasis in the Metaverse, future research could explore how diverse industries collaborate within virtual spaces to co-create value that crosses traditional boundaries. • This could include sectors like healthcare, education, and entertainment partnering to create hybrid environments (e.g., virtual wellness centers with entertainment and educational features) and assess how ecosystem synergies drive innovation and user engagement.
Study the richness vs. reach trade-off:	• Research could explore if and how the Metaverse addresses the balance between depth and scope regarding user involvement and satisfaction compared to conventional online platforms. Additionally, the research could investigate how personalized, immersive interactions scale effectively to large audiences, exploring the technology and design principles that enable firms to deliver high-quality, individualized experiences at scale.
Extend to physical brands, delve further into digital first	• Research could explore the alignment between digital and physical brand identities as firms integrate into the Metaverse, examining how digital experiences impact perceptions of physical products and vice versa. • This could involve studying whether consumers perceive products and services differently based on where they first encountered the brand (physical or virtual) and how Metaverse's presence influences long-term brand loyalty. • With the Metaverse's capacity for digital resources to precede and shape physical realities, future research could examine the emerging "digital-first" business models where virtual items and experiences define their physical counterparts. • Research could explore how customers view these products designed for platforms and evaluate the success of strategies that shift value from virtual to physical experiences across different sectors, like fashion retail, the housing market, and the consumer goods industry.
Expand into governance, regulations, and ethics	• As the Metaverse grows, understanding the role of governance in managing business activities, user rights, and content creation will become increasingly important in the value-creation process. • Research could address how firms navigate regulations and ethical considerations, particularly regarding intellectual property, data privacy, and digital ownership. • Examining the creation of governance models that balance business interests with user rights could inform best practices for Metaverse regulations. • With the potential environmental costs of operating in highly resource-intensive virtual spaces, the research could investigate how businesses can develop eco-friendly Metaverse strategies. • This might include studying energy-efficient technologies, sustainable virtual goods, and waste reduction in virtual production processes. • Such research could also examine consumer preferences for sustainable Metaverse engagement and whether environmental sustainability influences user loyalty and brand perception.
Expand to empirical and longitudinal	• With user-generated content and innovation central to Metaverse value creation, longitudinal studies could track how user-generated contributions impact brand identity over time. • Research could investigate whether brands benefit from user-led innovation or if it introduces risks that dilute brand messaging, especially as users gain autonomy to create digital goods and spaces affiliated with established brands. • This is also a crucial area for longitudinal time-series data.

Table A.6. Additional Research Opportunities Fostered by Xiong et al. [6]

Opportunity	**Specific Examples**
Examine various sectors and marketing channels over time	• Given that XR effects on offline transactions change, future research could explore whether these time-varying impacts vary significantly across various retail sectors (e.g., fashion, electronics, groceries). • Understanding how sector-specific characteristics influence XR's impact could help retailers refine XR strategies based on industry context and customer engagement patterns. • Because XR adoption appears to shift customer preference toward online engagement over time, future research could examine the efficacy of various cross-channel marketing strategies—such as loyalty programs, targeted promotions, or location-based advertising—in redirecting XR-engaged customers to offline stores. • A field experiment could test which strategies best drive foot traffic among customer segments engaged with XR.
Investigate user learning and adaptation to XR	• The study suggests that customers and staff may undergo a learning period with XR adoption. Research could investigate how users' adaptation and comfort with XR influence long-term engagement and purchasing behavior across online and offline channels. • By tracking user interactions over time, researchers could identify the optimal points to refresh or upgrade XR experiences to sustain interest and mitigate any declines in offline sales.
Examine the role of personalization in mitigating XR's negative impact:	• To address the long-term decline in offline transactions following XR adoption, future studies could explore whether personalized XR experiences help maintain positive offline sales. • Research could focus on how customization (e.g., customized product recommendations, custom avatars) within XR environments impacts user satisfaction and cross-channel shopping behavior over extended periods.
Examine the influence of XR on brand perception and loyalty	• Because XR eventually leads to a decline in offline transactions, future research could explore its impact on brand perception and customer loyalty. • Studies could investigate whether the immersive experiences fostered by the creation of XR improve brand affinity, even if they reduce offline store visits, and examine which factors influence customers' long-term loyalty to brands that offer extensive creation XR experiences.
Study the influence of offline store layout and design on online XR transactions	• Research could examine how offline store characteristics like layout, design, and sensory experiences interact with XR adoption. • A study could explore whether stores that integrate physical enhancements aligned with XR experiences (e.g., themed sections or interactive kiosks) mitigate the negative impact on offline transactions or enhance customer retention in the long term. • Given the dynamic nature of XR's effects, future research could develop predictive models to forecast the optimal periods for XR technology upgrades or enhancements. • By incorporating factors like customer engagement metrics, transaction volumes, and learning rates, predictive models could help retailers plan XR updates that maximize customer retention and revenue across online and offline channels.

Table A.7. Additional Research Opportunities Fostered by Marx et al. [3]

Opportunity	Specific Examples
Expand longitudinal empirical research on virtual distraction management	• Research could examine how knowledge workers adapt to distraction shielding and arousal filtering over extended periods. • Studies using a longitudinal approach could provide insights into how sustained exposure to Metaverse applications impacts focus, distraction resilience, and overall productivity over time, as well as whether these effects differ by worker role or task complexity.
Explore virtual workplace design for diverse personality types	• Because the study notes varying distraction needs and responses, future research could investigate how different personality traits, like introversion and extroversion, affect the efficacy of distraction shielding and arousal filtering. • Research could focus on designing and customizing Metaverse environments that accommodate diverse personality types, providing tailored virtual spaces that enhance productivity for each user profile.
Explore the impact of affordance customization on user autonomy and engagement	• The study highlights the potential for affordance customization in the Metaverse. Future studies could explore the link between customization options, user autonomy, and engagement, examining whether providing granular control over virtual affordances (e.g., interaction toggles, distraction filtering options) increases worker satisfaction, perceived autonomy, and sustained engagement in the virtual workspace. • Building on arousal filtering, future studies could evaluate AI-driven tools that adaptively manage distractions based on user behavior and task type. For example, AI could detect heightened stress or distraction and offer tailored suggestions or activate certain shielding features, such as dimming unnecessary notifications during focused tasks.
Explore the influence of different distraction types	• Researchers could examine how various types of distractions (e.g., auditory, visual, social) influence cognitive load in immersive Metaverse environments compared to traditional work settings. • Controlled experiments could identify which distractions are most disruptive and how the mental load differs, offering insights into optimal distraction management techniques for VR-based solo work. • Because some physical distractions (e.g., temperature, ambient noise) may impact virtual work despite being in a digital space, future research could assess the effects of external physical factors on cognitive performance in VR environments. This research could guide how to integrate better or adapt virtual workspaces to accommodate unavoidable real-world conditions.
Examine interventions for enhancing arousal filtering in high-stakes tasks	• Research could explore whether specific training interventions or virtual settings help workers better regulate arousal filtering in high-stakes or complex tasks. • Studies could investigate using features like guided meditative breaks, virtual nature environments, or personalized avatars to enhance cognitive resilience and reduce stress in distraction-heavy virtual workplaces.
Examine work-life boundary management and effects of persistent solo work	• Given the potential of the Metaverse to redefine work-life boundaries, future research could investigate how immersive workplaces impact workers' ability to separate work from personal life. This could involve exploring strategies like virtual "time-out" zones, limited access hours, or distinct digital environments for work versus leisure activities to aid boundary management. • Long-term immersion in virtual environments may influence motivation and mental well-being differently than physical spaces. Future research could explore how persistent virtual engagement affects intrinsic motivation for solo work, assessing whether immersive experiences lead to greater autonomy and focus or potentially increase fatigue and burnout.

Table A.8. Research Opportunities Fostered by Hanneke et al. [1]

Opportunity	**Specific Examples**
Investigate speculative behavior versus sustainable engagement in decentralized Metaverse economies	• Given that speculative activity may drive exchange rates without generating sustained economic engagement, future research could examine the factors differentiating short-term speculators from long-term economic actors. • Studies could assess how engagement incentives (e.g., loyalty rewards, exclusive access) influence speculative versus participatory behavior, providing insights for fostering sustainable user involvement.
Conduct a comparative analysis of decentralized and centralized Metaverse economies on creator profitability and digital scarcity	• Research could compare decentralized Metaverse platforms like The Sandbox with centralized Metaverse environments like Roblox to evaluate creator profitability, fee structures, and user retention. • Investigating how economic design affects creator income and platform loyalty could yield valuable insights for developers aiming to attract and retain creators in decentralized environments. • Research could assess how the enforcement of digital scarcity, a key feature of decentralized metaverses, impacts user behavior, asset valuation, and economic stability compared to centralized environments where scarcity may be less rigid. Understanding how digital scarcity affects transaction volume and asset liquidity could help inform strategies for sustainable asset creation.
Delve further into exchange rates and different cryptocurrencies	• The study indicates that new economic actors influence exchange rates more significantly than total economic actors. Future research could investigate these new actors' demographic and behavioral diversity, exploring whether specific types of users (e.g., institutional investors, small creators, gamers) contribute uniquely to exchange rate fluctuations and what factors sustain their participation. • Because many economic actors in The Sandbox conduct transactions using various cryptocurrencies, further research could examine the decision-making factors that drive users to choose one currency over another. • Insights could inform how to structure Metaverse economies to balance flexibility with token demand, ensuring sufficient liquidity while preserving economic stability.
Investigate economic resilience and market stability	• A longitudinal approach could provide insights into how economic dynamics shift over time as decentralized Metaverse economies evolve. • Research could assess whether early-stage incentives remain effective as the economy matures or if a growing ecosystem requires new mechanisms for retaining users and creators, especially as competition among metaverses intensifies. • Future studies could explore the potential for decentralized Metaverse economies to withstand fluctuations in the broader cryptocurrency market. • Research could identify and evaluate stabilization mechanisms, such as dynamic token supply adjustments or decentralized autonomous organization (DAO) governance, to assess their effectiveness in maintaining economic resilience.
Assess the roles of and impact of government regulation	• Hanneke et al. [1]: Building on the finding that Metaverse government actions affect new actor engagement, future research could explore how governmental involvement influences digital asset quality and perceived value. • Studies might assess whether government-sponsored asset creation supports higher quality or more innovation than user-generated assets, shaping long-term value in the Metaverse economy. • As decentralized economies face regulatory uncertainties, future research could evaluate the impact of regulatory frameworks like the EU's MiCA on user participation, token value, and investor confidence. • Research could explore how local versus global regulations affect decentralized economy dynamics and suggest regulatory approaches to protect users without stifling innovation.

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