Augmented Reality and the Metaverse – Speculating about the Future

Shahper Richter
Business School
University of Auckland
Email: shahper.richter@auckland.ac.nz

Nastaran Mohammadhossein
School of Information Management
Victoria University of Wellington

Alexander Richter
School of Information Management
Victoria University of Wellington

Matthias Trier
Chair of Information Systems, Social Computing
Paderborn University

Abstract

Imagine a world where the boundaries between physical and digital realities dissolve, creating immersive experiences that transform how we interact. This potential lies at the heart of the Metaverse, and a confluence of technologies such as AR, VR, AI and blockchain will be the key to unlocking it. We employ a novel combination of horizon scanning and narrative development to explore the transformative role of AR within the Metaverse. This approach reveals potential technology-driven futures, highlighting emerging trends and disruptions not readily apparent through traditional forecasting methods. Our narratives of the future offer surprising glimpses into potential sociotechnical futures, informing a research agenda for both industry and academia.

Keywords: Metaverse, Future Thinking, Augmented Reality, Sociotechnical Lens

1 Introduction

The Metaverse is a continuously evolving virtual realm where users can interact and engage in diverse personal and social activities in an immersive environment at the crossroads of technological innovation and societal transformation (Dolata & Schwabe, 2023; Richter & Richter, 2023). It is a sociotechnical phenomenon, amalgamating various technical components such Blockchain, Virtual Reality (VR), and Artificial Intelligence (AI). In this paper, we use Augmented Reality (AR) as a primary example to explore the disruptive potential of emerging technologies within the Metaverse. AR technology's increasing integration into the Metaverse is poised to redefine user interactions, acting synergistically with other transformative technologies to enhance functionalities and security (Fu et al., 2022).

However, our focus is not limited to this single technology. Even if the all-encompassing vision of the Metaverse may currently be less salient in the media and perhaps even becomes replaced with newer industry tags such as Spatial Reality, the many practical applications of AR remain one component in this continuing socio-technological change (Anderson & Rainie, 2022). While existing research explores the technical capabilities of AR and other technologies

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within the Metaverse (Chen et al., 2024; Geroimenko, 2024), a significant gap exists in understanding how these technologies will shape future user experiences, particularly from a holistic, sociotechnical perspective. Most studies explore the technologies in isolation or use current implementation data. We are using future thinking techniques to understand what these technologies may do. This is where our work fills in the current gaps in understanding.

Therefore, we examine the implications of the Metaverse for organisations and society. Our study highlights how AR and other technologies realise their full potential within this immersive digital realm. We use a forward-looking approach to understand the interplay of these disruptive technologies**.** Horizon scanning allows us to identify early signals and emerging trends that may shape the trajectory of technology integration within the Metaverse (Cuhls, 2020). Constructing future narratives (Amer et al., 2013) helps us better understand the implications of those various developments and explore how different social, technological, and environmental factors may interact to shape user experiences and societal outcomes.

As the Metaverse continues to evolve, integrating different technologies will present unprecedented opportunities and potential challenges. Early identification and understanding of these dynamics enable stakeholders to develop strategies that leverage technology benefits while mitigating risks. By offering insights that inform decision-making processes, we can ensure the integration of various technologies in the Metaverse fosters innovation and responsible development.

With our work, we aim to contribute to a more structured and actionable understanding of what the Metaverse can become by focusing on AR technologies and their potential applications. By utilizing future-looking narratives, we help stakeholders, whether developers, policymakers, or users, identify challenges, opportunities, and transformative potentials. From a methodological standpoint, we demonstrate the systematic integration of horizon scanning and envisioning narratives as a futures-thinking research approach for IS. In the next sections, we position the Metaverse, and the use of AR in it, as a sociotechnical phenomenon (Section 2), illustrates our methods (Section 3), presents a narrative analysis (Section 4), the results of this analysis (Section 5), a discussion (Section 6), research agenda (Section 7) and conclusion (Section 8).

2 Background

2.1 The Metaverse

The concept of the Metaverse, a virtual realm that coexists with the physical world, has acquired significant attention from technology commentators and academics (Richter & Richter, 2023). The idea of the Metaverse was originally introduced in Neal Stephenson's 1992 novel "Snow Crash," where it is depicted as a virtual reality (VR) space that uses the internet and augmented reality (AR) through avatars and software agents (Joshua, 2017). Although there is no consensus on a definitive definition, Damar (2021) succinctly defines it as "the layer between you and reality", acknowledging that the Metaverse integrates physical, augmented, and virtual reality, and allows users to express themselves using digital identities. With the right infrastructure, it provides a converged experience for users in both the virtual and real worlds, which can be used for a variety of purposes, including games and social interactions (Hollensen et al., 2022). AR, as an integral component, adds layers of realism to the Metaverse, enriching user experiences through immersive interactions (Wright et al., 2008). Laeeq (2022) provides an illustrative example of the use of AR: "The metaverse is intended to use augmented reality at some point in the future. This is where you'll be able to see "holograms" of the Metaverse against the background of the real world with AR glasses.”. While this beneficial interplay has been pointed out at such aggregate levels, there is so far no detailed picture emerging of how AR can precisely contribute to the proliferation of the metaverse. Answering this question requires to understand the value of AR from a socio-technical perspective, which we are outlining in the next section.

2.2 The Value of AR

Augmented Reality (AR) traces its origins back to the 1950s, but its widespread consumer applications have emerged in the 21st century, primarily driven by the proliferation of mobile devices (Ahmad & Junaini, 2020; Yuen et al., 2011). AR technology presents layered information on various portable screen devices, including stationary devices like AR mirrors, mobile devices such as smartphones, or wearable devices like AR glasses (Flavián et al., 2019). According to Magerkurth et al. (2005) “Augmented reality is a variation on virtual reality that draws virtual objects into a real-world environment.” Nonetheless, it is not virtual reality since it uses virtual images within a live, in-world environment. Unlike virtual reality, which creates entirely immersive digital environments, AR overlays virtual images onto the physical world, offering users contextual information as they navigate real-world spaces (Dwivedi et al., 2022).

AR applications are increasingly used in a wide range of fields today, and they can be applied practically in almost every aspect of daily life (Dargan et al., 2023). Several researchers have recognized that AR applications provide new opportunities in different fields due to their all-in-one nature, including images, animations, or videos (Ahn et al., 2019; Baroroh et al., 2020; Bottani & Vignali, 2019). For instance, games used to be played outside, but now they are played indoors using wearable headgear and other display technologies (Buruk et al., 2024). AR can improve efficiency and accuracy in manufacturing by providing workers with real-time information and guidance (Porter & Heppelmann, 2017; Tao et al., 2019). For example, AR can overlay instructions on machinery, allowing workers to quickly and easily understand how to operate it, and to make repairs and adjustments (Eswaran et al., 2023). Additionally, AR can create virtual mock-ups of products and simulate assembly processes, allowing engineers and designers to identify potential problems early in the design process (Eswaran et al., 2023).

In the domain of cultural heritage and tourism, AR enhances visitor experiences by providing interactive interpretations and re-engineering tourism encounters at historical sites and museums (Yovcheva et al., 2014). In places like the Acropolis in Athens, Greece, or the Pyramids in Cairo, Egypt, this would provide unprecedented interpretation opportunities (Dwivedi et al., 2022). As a result, brands and destinations can engage with visitors in real-time on location, revolutionizing their travel experience (Buhalis & Amaranggana, 2015; See et al., 2016).

AR's impact extends into education, where it creates interactive and immersive learning experiences, enabling students to visualize complex concepts and explore virtual environments (Akcayir & Akcayir, 2017). The Curiscope Virtuali-Tee, for instance, uses augmented reality to let students view the inside of the human body as if they were in an anatomy lab (Gohd, 2017). This can make education more engaging and effective and can also help to improve the retention of information (Majeed & Ali, 2020).

Moreover, AR technology has made significant strides in the medical field, offering comprehensive solutions for medical education, surgical planning, and patient management (Bagwe et al., 2021). Surgeons can utilize AR to simulate complex procedures, receive real-time guidance during operations, and train medical students in hands-on environments (Hampiholi, 2023).

In retail, AR enhances the shopping experience by offering dynamic 3D animations and realistic interfaces, allowing customers to interact with products virtually before making purchases (Scholz & Smith, 2016). Retailers leverage AR to enable virtual try-ons for clothing and visualize furniture in real-world settings, providing customers with enhanced confidence and convenience in their purchasing decisions (Bonetti et al., 2018; Pachoulakis & Kapetanakis, 2012).

In the Metaverse, AR brings transformative possibilities but also unique challenges. Its integration requires advanced technology, which can be costly and complex (Rabbi & Ullah, 2013). User acceptance is crucial (Sumadio & Rambli, 2010), demanding intuitive and engaging experiences. Privacy and ethical concerns (Blodgett-Ford & Supponen, 2018; Neely, 2019) surrounding data usage must be addressed to ensure responsible deployment.

Therefore, while AR offers immense potential in the Metaverse, success relies on overcoming challenges and navigating ethical considerations. A socio-technical approach can guide stakeholders in designing inclusive, innovative AR solutions aligned with societal values.

2.3 A Sociotechnical Perspective on AR in the Metaverse

After having introduced the technological foundations and value of AR and the metaverse we need a suitable theoretical lens to emphasize how users in their social contexts make use of the technology to realize its value. The sociotechnical lens helps to understand user engagement by considering the social context in which AR technology is used (Sarker et al., 2019). As technologies like AR directly alter our perception of the real world by overlaying digital information, they reshape how humans interact with their surroundings. This is particularly salient in the realm of AR, which serves as a bridge between the digital and physical realms. The very essence of AR and the Metaverse is the mutual appropriation of social structures and technical functionalities, where both elements are "constitutively entangled" (Orlikowski, 2007).

In the context of the Metaverse, the sociotechnical view can be used to understand how the design and functionality of AR technology impact user behaviour. For example, the level of interactivity and immersion provided by AR technology can influence user engagement and motivation to use it (Shin, 2019; Yim et al., 2017). Additionally, it helps us to understand how the technical design of AR technology can impact the potential for deviant behaviours (Li et al., 2022), such as how anonymity and lack of physical cues in the Metaverse can contribute to deviant behaviour (Dwivedi et al., 2022), necessitating continuous design and redesign based on human engagement. This iterative process, as emphasized by Kallinikos et al. (2013), ensures that technology evolves in tandem with societal needs and values. This evolution is underpinned by the philosophy of human-centered design, which underscores the importance of focusing on individuals and groups when crafting technologies. By doing so, we ensure that emergent technologies are not only functional but also user-friendly and aligned with human values.

Recognizing and understanding these systemic interactions in a larger system that encompasses human actors, societal norms, and other technologies (Sarker, Chatterjee, et al., 2013), is crucial for the successful integration and widespread adoption of new technologies like AR. This interconnectedness means that sociotechnical systems are dynamic entities. As society evolves, so too will the technologies it adopts and the manners in which they are utilized. For example, the sociotechnical view can be used to understand how social norms and expectations in the Metaverse shape user behaviour, such as how the perceived anonymity of the Metaverse can lead to deviant behaviours. Additionally, the sociotechnical helps to understand how the social context in which AR technology is used in the Metaverse can impact user engagement (Scholz & Smith, 2016), such as how the presence of a supportive community can increase user engagement and motivation to use AR technology in the Metaverse.

Investigating the Metaverse from a sociotechnical viewpoint poses the challenge that many practices have not yet materialized or matured. Our methodological approach offers a detailed and holistic structure that allows us to imagine a wide range of potential futures. Specifically, it facilitates the exploration of diverse narratives in which technology and societal factors might develop along various paths. By deeply understanding the intertwined nature of technology and society, those at the forefront of innovation and policymaking are better equipped to make informed decisions. Their choices can then reflect a balance between technological advancements and societal expectations. In the context of emerging technologies like AR, this means ensuring that their design, development, and implementation align seamlessly with societal values, meeting the broader needs and aspirations of the community.

3 Methods

3.1 Horizon Scanning

Given the exploratory nature of the Metaverse and the rapidly evolving capabilities of AR technologies, it is essential to adopt a methodology that can navigate uncertainty and identify emerging trends. Horizon scanning is ideally suited for this purpose, as it allows researchers to identify potential future narratives, opportunities, and challenges in a given context (Flick et al., 2020). Web-based horizon scanning systematically gathers information from various sources, including academic research, industry reports, white papers, and the social media discourse, embracing a wide array of insights from both empirical and speculative perspectives (Nemorin et al., 2023; Washida & Yahata, 2021; Welz et al., 2021).

Given the nascent and rapidly developing nature of the Metaverse and AR technologies, the use of horizon scanning allows for a structured approach to gather data from diverse sources and develop narratives of the future. The identification of new issues through horizon scanning is especially valuable in such an unexplored context. Similar approaches have been effectively applied to anticipate future developments in areas such as the future of work and artificial intelligence. For instance, Jetha et al. (2021) utilized horizon scanning to examine the impact of evolving work conditions on vulnerable workers, while Nemorin et al. (2023) employed the method to explore discourse on AI in education and development.

Horizon Scanning at the beginning of a forward-looking activity is applied for identifying "things to come," often new science and technology (Conway, 2021). Horizon scanning involves a systematic examination of potential opportunities, threats, and trends across a wide range of domains, while narrative planning constructs multiple plausible narratives of the future. The use of narrative development allows a more in depth and rigorous approach to the identification and impact of these trends, by enabling a detailed analysis of potential consequences. By combining these approaches, the study aims to inform decision-making processes and enhance organizational adaptability in an ever-evolving global landscape.

For this study, we operationalised horizon scanning by establishing a structured framework that detailed the specific types of sources to be reviewed, the criteria for information relevance, and the methods for data extraction and analysis. They included academic journals at the forefront of exploring the Metaverse, business magazines, reports from business forums and white papers, posts, podcasts, and videos by company evangelists and academics on social media like LinkedIn and YouTube videos, and technology blogs and newspaper publications. Each source was scrutinised using a set of predetermined criteria to ensure consistency and rigor in the data collection process. As a result, we identified, analysed, categorized, and synthesized more than 200 sources of information on AR in the Metaverse. Based on this analysis, we created future narratives based on these trends. Horizon scanning is useful for identifying emerging issues, but synthesizing the information to understand key driving forces is even more valuable (Cuhls, 2020; Rowe et al., 2017).

3.2 Narratives of and for the Future

Narrative development in futures studies is a powerful approach that combines the crafting of compelling stories with the insights gained from horizon scanning to explore potential future outcomes. This process transforms abstract data and emerging trends into coherent narratives, making complex future possibilities more tangible and relatable for stakeholders (Burnam-Fink, 2015). As Schoemaker (1995) argues, detailed and realistic narratives can direct attention to latent trends, wildcards, and weak signals that might otherwise be overlooked. This combination of narrative development and horizon scanning offers several key benefits, including enhanced visualization and engagement, improved decision support, and strategic foresight enhancement (Ringland, 2010).

Narratives serve as a crucial bridge between scenarios and action, transforming passive anticipations into active engagement by providing a structured framework for decision-making. By enabling stakeholders to "visit" potential futures through these rich narratives, organizations can extend their understanding and actively shape the future (Schwarz, 2015). This approach allows decision-makers to more effectively envision and engage with and comprehend possible futures, fostering a deeper understanding of potential challenges and opportunities (Inayatullah, 2008). The integration of narrative development with horizon scanning creates comprehensive decision support products, bridging the gap between raw data and actionable insights (Iden et al., 2017). Furthermore, narratives derived from horizon scanning results serve as powerful tools for communicating complex future narratives to diverse audiences, facilitating more effective strategic conversations and collaborative decision-making processes (Curry & Schultz, 2009).

3.3 5 Step Process

Washida and Yahata (2021) found that horizon scanning-based narratives provided significantly higher predictive value than narratives prepared using conventional methods. In our approach, each identified trend from the horizon scanning was evaluated for its potential impact and likelihood, enhancing the predictive value of the narratives developed. Using web-based horizon scanning when creating narratives is especially useful as it can provide evidence for the narratives and ensure they align with present circumstances and strategy, rather than just presenting an opportunity for speculative thinking about a future disconnected from current relevance (Rowe et al., 2017; Schoemaker et al., 2013)

We followed a five-step process (Figure 1), starting with defining our search criteria and keywords, moving to automated and manual scanning of diverse forms of data, combining our findings into a comprehensive database and finally utilising this data to generate exemplary narratives (Cuhls, 2020; Washida & Yahata, 2021). This approach was informed by hermeneutic principles (Boell & Cecez-Kecmanovic, 2014) and designed to foster a comprehensive and nuanced understanding of AR in the Metaverse. The steps taken ensured that the methodology was not only described but also clearly linked to how it was concretely applied in the research effort, emphasizing the practical execution and the rigorous analysis conducted.

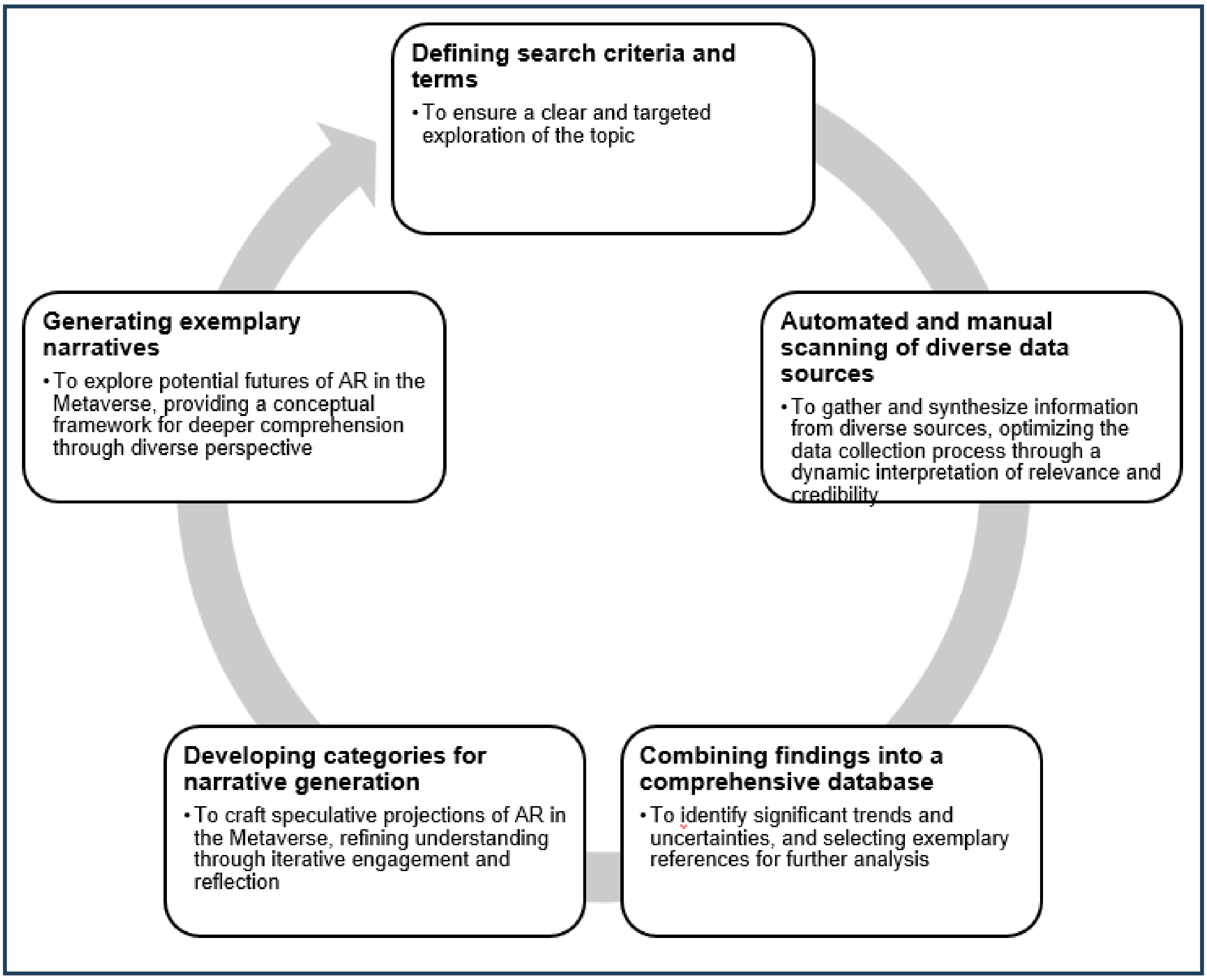

Figure 1: Horizon Scanning and Narrative Development – A 5 Step Process (authors' own creation)

Step 1: Defining search criteria and terms
Defining our search criteria and selecting relevant keywords was crucial for setting a clear direction for the following scanning processes. It was guided by the hermeneutic principle of establishing interpretive criteria based on key concepts "Augmented Reality," "Metaverse," and "applications of these technologies." The search was conducted across academic databases, including IEEE Xplore, ACM Digital Library, and Web of Science, industry reports from market analysis companies (e.g., Gartner, Forrester), white papers from research

organizations, and public social media platforms (e.g. Reddit, X) . We employed search strings such as ("augmented reality" OR "AR") AND ("metaverse" OR "virtual world") AND ("user experience" OR "interaction" OR "engagement") AND ("societal impact" OR "ethical issues" OR "future trends"). This deliberate and thoughtful preparation ensured a targeted yet comprehensive exploration of the field.

Step 2: Automated and manual scanning of diverse data sources
Our horizon scanning process employed both automated tools and manual efforts. Automated methods sifted through academic databases, industry reports, white papers, and social media platforms, identifying content that matched our predefined criteria and keywords. Simultaneously, we undertook manual reviews to synthesize the gathered information, applying expert judgment to interpret complex data and evaluate sources critically. The inclusion criteria for our automated and manual scans stipulated that sources be published in English between 2020 and 2025 to remain current, focus on the application of AR within the Metaverse, address societal impact or ethical issues, discuss future trends, or describe technological innovation. Sources that focused solely on virtual reality, or did not address future impacts were excluded. The combination of automated and manual methods allowed us to leverage the strengths of both approaches, optimizing our data collection process. This step embodied the hermeneutic practice of engaging with diverse knowledge sources, facilitating a dynamic fusion of horizons where our interpretations of "relevance" and "credibility" continuously evolved (Gadamer, 2013).

Step 3: Combining findings into a comprehensive database
The integration of our findings into a comprehensive database was done by organizing information from over 200 sources into categories such as technological innovations and societal implications. This step was instrumental in identifying significant trends, patterns, and uncertainties, enabling us to develop categories that would later inform our narrative generation. The methodological rigor of this phase is underscored by our selection of 45 exemplary references, included as Endnotes in the Analysis section,

Step 4: Developing categories for narrative generation
We proceeded to develop categories that served as inputs for generating exemplary narratives. This analytical phase allowed us to synthesize the vast array of data collected, drawing upon key drivers of change and uncertainties to craft speculative yet grounded projections of the future of AR in the Metaverse from a sociotechnical perspective. This step exemplified the hermeneutic principle of iterative engagement and reflection, as our understanding of the data and its implications for AR in the Metaverse continued to refine and deepen.

Step 5: Generating narratives
Finally, we utilized the synthesized data to generate narratives, illustrating potential futures of AR in the Metaverse. These narratives provided a conceptual framework for exploring the complexities and potential developments within AR and the Metaverse, embodying the hermeneutic approach of achieving deeper comprehension through the integration of diverse perspectives. The generation of these is described in more detail in the next section.

4 Categories for narrative generation

In the categories for narrative generation, we focus on customers as a particular user role. Their activities are typically categorized into a customer journey model with three stages. By utilizing the customer journey model—encompassing pre-purchase, purchase, and post-purchase phases—we were able to align AR technological capabilities with specific customer interactions and expectations at each stage. This alignment provided a structured approach to synthesizing the vast array of data collected, drawing upon key drivers of change and uncertainties to craft speculative yet grounded projections of the future of AR in the Metaverse from a sociotechnical perspective. A customer journey is a sequence of steps that a customer goes through to access or use a company's offerings (Følstad & Kvale, 2018). It puts the customers' perspective at the center of all design considerations. Analyzing customer journeys can help to understand key points in the customer experience and how they impact the customer's overall experience (Rawson et al., 2013). Briefly, these stages differ regarding the goals and activities companies pursue within each step. The pre-purchase stage includes customer interactions before the purchase, such as identifying needs, discovering a product or brand, searching for information, and evaluating alternatives. Customers may be motivated by utilitarian or hedonic factors (Mikalef et al., 2012). They may rely on extrinsic cues, such as brand credibility and social sources to reduce information uncertainty (Ho et al., 2015). The purchase stage involves customer interactions with a platform during the actual purchase event, including processes related to choice, ordering, and payment (Lemon & Verhoef, 2016). Customers may experience choice overload or be dissatisfied with their decision, potentially leading to abandoned or postponed searches or purchases (Wang & Shukla, 2013). The post-purchase stage encompasses customer interactions with a platform after the purchase, including usage, consumption behavior, post-purchase engagement, and word-of-mouth (WOM) through reviews, among other things (Lemon & Verhoef, 2016).

For each phase we distinguished between the driver (the technological changes) and the uncertainty (or what users are weary of) and together used these to derive the hypothetical narrative (cf. Figure 2).

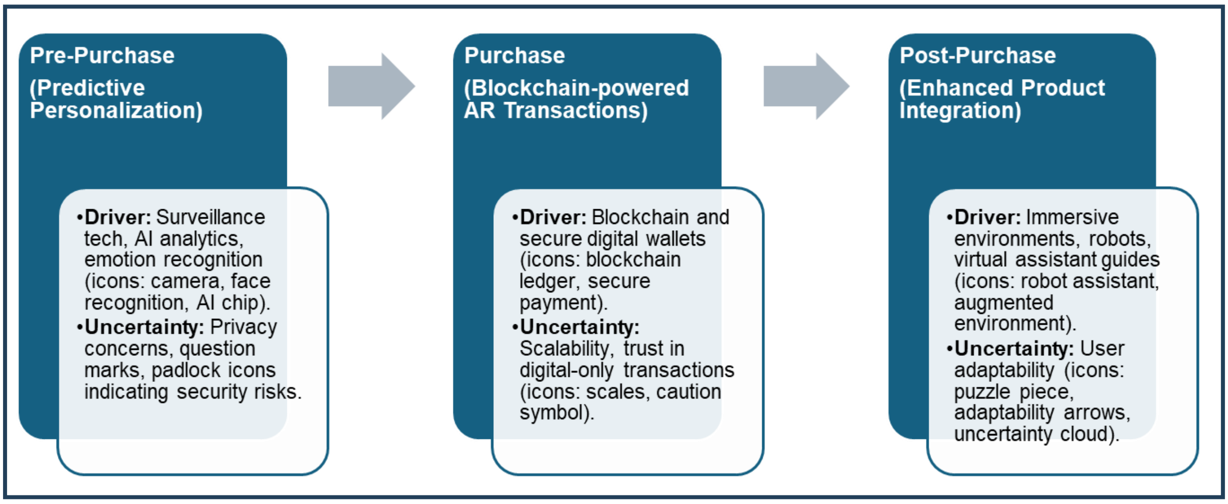

Figure 2: Drivers and uncertainties in each phase

As AR and Metaverse technologies continue to evolve, advancements in hardware design and manufacturing have significantly reduced costs, making immersive experiences more accessible to a broader range of users (Nair et al., 2024). The increasing availability of lightweight AR glasses and mobile-based applications has expanded participation beyond early adopters, allowing everyday consumers to engage with AR-enhanced experiences in personal and professional contexts (Pavlik & Bridges, 2013; Singh et al., 2025). This democratization of technology ensures that the benefits of AR, such as personalized shopping, secure transactions, and enhanced post-purchase experiences, are no longer limited to premium markets but can support inclusive and diverse user groups.

4.1 Pre-purchase Phase – Predictive Personalization

Driver: Recent advancements in surveillance technologies (FlySight, 2024) and AR combined with facial recognition (Lun & Iqbal, 2024) demonstrate significant progress in the field. For instance, Kleinings (2023) outlines various applications of AI in business, while Cropley et al (2023) discusses the creative potential of algorithmic design. Furthermore, the integration of autonomous supply chain planning (Hendricksen, 2023; Sharifmousavi et al., 2024) and the capability of robots to interpret human emotions (Stock-Homburg, 2022) highlight the practical applications of these technologies. The improvements in computational experience through AI-enabled task offloading (Rawlley et al., 2025) and the development of intelligent visual-IoT systems (El Ghati et al., 2024) further underscore the importance of these advancements. Finally, the future potential of AR and AI is evident in the innovative approaches discussed by Devagiri et al (2022).

Uncertainty: Recent discussions on the metaverse have highlighted various privacy concerns and technological advancements. For instance, Kaur et al (2024) explores how privacy is taken into account in AR/VR experiences, while Al Falahi et al (2024) warns of serious privacy risks for users within the metaverse. Okhifun (2022) demonstrates how AI can mitigate workplace stress, complementing Parlar (2023) insights on data privacy and security in the metaverse. Moreover, Richter & Richter (2024) touch on the use of self-aware agents to analyze public self-consciousness in complex narratives like the iterated prisoner's dilemma. Crum & Coglianese (2024) highlights AI's potential to understand and interpret body language, which is further supported by Ergen (2021) examination of AI applications in event management and marketing. Goher (2024) outlines the benefits of AI-driven scheduling, emphasizing the efficiency gains in various sectors. Additionally, Xu et al,(2022) discuss broader security and privacy concerns in the metaverse, underscoring the importance of comprehensive protective measures in these digital spaces.

Narrative Development: In the pre-purchase phase, predictive personalization uses AR to enhance user engagement by adapting product visualizations based on real-time emotional and physiological feedback (V. Kumar et al., 2024; Valmorisco et al., 2024). This narrative was developed by considering how customers explore options and make decisions (Koo et al., 2021). The integration of AR with AI analytics caters to personalized shopping experiences, a critical factor as users seek more tailored interactions in digital spaces (Agriyanto, 2024; Mohamed et al., 2024; Venkata et al., 2024).

4.2 Purchase Phase – Blockchain-Powered AR Transactions

Driver: In the purchase phase, the integration of blockchain technology for secure, transparent transactions is a significant driver. This approach ensures that transactions within the metaverse are both reliable and verifiable (Ghosh et al., 2024; Pragha et al., 2024; Rafique & Qadir, 2024). Additionally, the use of blockchain in augmented reality platforms further enhances the security and transparency of digital transactions (Logeswaran et al., 2024).

Another key driver is the ability of blockchain to create a secure and efficient virtual world. This capability is crucial for enabling a seamless purchase experience in the metaverse (Al Khaldy et al., 2024; Aldweesh et al., 2023). The combination of these technologies supports the creation of a trustworthy environment for users, thereby boosting their confidence in making digital-only transactions (Ng, 2023).

Uncertainty: Scalability of blockchain solutions and user trust in digital-only transactions. a significant uncertainty is the scalability of blockchain solutions and user trust in digital-only transactions. Blockchain and its derived technologies are shaping the future of digital businesses, particularly in decentralized finance and the metaverse (Far et al., 2023). However, the integration of these technologies into mainstream commerce poses questions about their scalability and reliability (Ghosh et al., 2024). Another uncertainty is the impact of artificial intelligence on event experiences and user interactions within the metaverse. The application of AI in enhancing event experiences through narrative techniques highlights both opportunities and challenges in user adaptation (Neuhofer et al., 2021). The comprehensive review of blockchain technology and virtual asset accounting in the metaverse also underscores the complexities involved in establishing a trustworthy and efficient virtual economy (Uddin et al., 2024). Furthermore, the integration of blockchain within the industrial metaverse introduces additional layers of uncertainty regarding the seamless operation and user trust in these systems (Mourtzis, 2024). Addressing these uncertainties is crucial for fostering user confidence and ensuring the smooth adoption of these advanced technologies.

Narrative Development: The purchase phase narrative leverages AR and blockchain to create a seamless and secure transaction environment. This development was motivated by the need to enhance user confidence during online purchases (Patel, 2024). By embedding blockchain within AR interfaces, we address both the technical capability of AR to provide immersive interactions and the social requirement for trust and security in financial transactions (Logeswaran et al., 2024). The immersive experience of augmented reality, such as trying a virtual meal, exemplifies the potential of AR to engage users in innovative ways (Cowan et al., 2024).

The integration of AI within organizational frameworks also supports the collaborative environment necessary for effective business operations (Chowdhury et al., 2022). Understanding blockchain trends and their application to business practices further ensures that these technologies are effectively implemented (Gad et al., 2022). Additionally, comprehensive guides on the metaverse provide essential insights into the broader context of these technological advancements (Fadhel et al., 2024).

4.3 Post-purchase Phase – Enhanced Product Integration

Driver: Evolution of AR capabilities to interact with physical environments. the evolution of AR capabilities to interact with physical environments is a key driver. This interaction is vital for helping users integrate and utilize their purchases effectively (Ebrahimabad et al., 2024). The potential of AR in enhancing user experiences through immersive technology is significant (Baxter & Hainey, 2024). Simulation optimization techniques, such as kriging, contribute to improving the efficiency and effectiveness of AR applications in real-world narratives (Wei et al., 2023). Additionally, the long-term vision of the metaverse and its impact on future interactions highlight the importance of continuous development in AR and AI technologies (Rainie & Anderson, 2024). The role of robots, AI, and service automation in post-purchase narratives is also crucial for enhancing customer support and interaction (Smith et al., 2023). Advanced applications of VR in medical fields, such as neurosurgery, demonstrate the broad potential of immersive technologies (Chang & Wu, 2024). Furthermore, the exploration of 3D virtual worlds and the metaverse indicates the ongoing advancements and future possibilities in this domain (Uddin et al., 2024; Zalan & Barbesino, 2023).

Uncertainty: User adaptability to augmented spaces in personal environments presents a significant uncertainty. Acceptance of the metaverse, as explored through laboratory experiments on augmented and virtual reality shopping, indicates varying levels of user acceptance and adaptation (Xi et al., 2024). The complexity of metaverse digital environments, including the techniques, technologies, and applications, further contributes to this uncertainty. The potential opportunities within the metaverse are vast but realizing them depends on user adaptability and technological integration (Allam et al., 2022). Marketing within the metaverse also faces uncertainties related to how these environments will shape future consumer research and practice (Dwivedi et al., 2022). The integration of virtual assistants in event planning and the overall impact of the metaverse on human resources highlight the broader implications of these uncertainties (Fadhel et al., 2024).

Narrative Development: In the post-purchase phase, AR assists users in integrating and utilizing their purchases through interactive, context-aware guides and setups. This narrative was crafted considering the need for ongoing engagement and support after a purchase, ensuring that AR adds value beyond the initial transaction by enhancing the usability and enjoyment of products (Flavián et al., 2024). AR has been shown to significantly impact the customer journey by providing an immersive experience that extends beyond the point of sale (Romano et al., 2021).

The role of AR in marketing is increasingly recognized for its ability to create interactive and engaging customer experiences (Rauschnabel et al., 2022; Tom Dieck & Han, 2022). For instance, AI for events demonstrates how AR can be incorporated to enhance participant engagement and experience (Sung et al., 2021). Developing a theoretical framework for augmented reality marketing helps to understand its potential and applications in retail environments (H. Kumar et al., 2024; Rehman et al., 2024). The ability of AR to transform how consumers interact with their purchases is further highlighted by applications in virtual dining and exploration, providing users with a rich, immersive experience (Chiu et al., 2021). The exploration of virtual worlds through AR also contributes to AI learning in new ways, enhancing the overall user experience (Verhulst et al., 2021). Moreover, transforming customer experience using AR/VR technologies demonstrates the potential for these tools to add significant value post-purchase (Patel, 2024). Partnering with AI, as seen in digital productivity assistants, showcases how AR can support ongoing user engagement and productivity (Cranefield et al., 2023). Additionally, marketing research on mobile apps emphasizes the evolving nature of AR technologies and their impact on future marketing strategies (Rauschnabel et al., 2022; Stocchi et al., 2022).

4.4 Reflection

The analytical phase allowed us to apply the hermeneutic principle of iterative engagement and reflection. Our understanding of the data and its implications for AR in the Metaverse continued to refine and deepen throughout the process. By linking these narratives to specific phases of the customer journey, we ensure that each narrative addresses distinct aspects of user interaction, reflecting both current technological trends and potential future developments. This approach not only aids in envisioning how AR might evolve within the Metaverse but also grounds these developments in practical, user-centered applications that are critical for widespread adoption and satisfaction.

In this section, we present narratives aiming to offer a comprehensive understanding of the potential new approaches to integrating AR into the Metaverse derived from rigorous analysis of 45 exemplary references collected through the horizon scanning approach. Employing an expanded sociotechnical lens (Sarker et al., 2019; Sarker, Xiao, et al., 2013), not only captures the dynamic interplay between AR technology and its users but also situates it within broader societal contexts, offering a holistic view of AR's potential in the Metaverse.

In order to derive a more realistic narrative we orient our discussion of AR use around a specified user persona. Personas serve as representations of various stakeholder roles, assisting in guiding the information design process (Reeder & Turner, 2011). They outline the characteristics of individuals who will engage with an information system. As a valuable reference tool, personas aid designers in their work. When combined with narrative-based design, they become a powerful method for enhancing the quality of information designs (Jansen et al., 2022).

User Persona: Sarah is a 22-year-old Environmental Science student at Metaverse University (MU). As digital native Sarah is comfortable with VR and AR technology. She values flexibility and the ability to control her learning experience and prefers virtual environments where she can network with other professionals in her field.

5 Narratives of the future of AR in the Metaverse

5.1 Pre-purchase Phase: Predictive Personalization with AR

Sarah has recently joined a new virtual living community within the Metaverse, designed to mimic a bustling modern city. As she navigates her virtual apartment through her avatar, she decides it needs a new sofa to enhance the space's aesthetic and functionality. Sarah puts on her AR-enabled visor in her physical space, which seamlessly connects with her virtual environment in the Metaverse. As she explores different sofas in a virtual furniture store, the AR system integrated with advanced AI syncs with her neural interface. This interface reads her subconscious signals and micro-expressions to understand her preferences. In her real-world space, she sees virtual sofas overlaid in her physical room, adjusted for scale and style according to her virtual apartment's dimensions. When she pauses on sleek, modern designs, the virtual system dynamically adjusts the options, highlighting similar styles that appear in her virtual living room.

Having recently upgraded to a more affordable AR visor, Sarah appreciates how accessible the technology has become, allowing her to engage in immersive experiences without premium equipment. She recalls how, until recently, such experiences were limited to high-end devices, but now lightweight AR glasses and mobile applications have made virtual shopping widely available, allowing her to personalize her space with ease.

Noticing her focus on a particular plush, navy-blue sofa, the system in the Metaverse enhances the texture and comfort level to appear softer, responding to Sarah’s neural feedback indicating a preference for comfort. She can see and feel the adjustments in real-time through haptic feedback gloves, providing a tactile experience as if touching the sofa. Thrilled by this deep level of interaction, Sarah confirms her choice. The sofa not only fits perfectly in her virtual space but also enhances her sense of presence within the digital world, making her virtual home feel more inviting and personalized.

5.2 Purchase Phase: Seamless and Secure Transactions

Satisfied with her virtual sofa selection in the Metaverse, Sarah is ready to finalize her purchase. Within the digital environment, she uses a gesture to bring up the purchase interface. Instantly, a 3D holographic contract projects right in front of her avatar, appearing in the virtual living room she has been decorating. The contract details—including terms, warranties, and the simulated delivery timeline—are displayed in a user-friendly, interactive format. She navigates the contract using voice commands within the Metaverse, confirming that the virtual delivery aligns with her preferences in the digital world.

To proceed with the purchase, Sarah authorizes the transaction via a retina scan performed by her AR visor in the real world, which seamlessly integrates with her digital actions. This dual-layer authentication, leveraging blockchain technology, ensures that the agreement is not only secure but also intrinsically bound to her identity across both realms, significantly reducing the risk of fraud. This method provides a unique blend of real-world security measures with Metaverse transactions, enhancing her confidence in the system's transparency and reliability. The blockchain technology records her purchase within the Metaverse, providing an immutable ledger that guarantees all terms are honored as agreed, both virtually and in any linked real-world interactions. This transaction showcases how AR and blockchain can create a fluid, secure bridge between digital and physical experiences, ensuring that virtual goods and services in the Metaverse carry tangible credibility and legal weight.

5.3 Post-purchase Phase: Integration into Daily Life

After the virtual delivery of her new sofa in the Metaverse, Sarah is eager to explore its capabilities. She dons her advanced AR glasses, which bridge her physical living space with her virtual environment. The AR system scans both her real apartment and her virtual space, projecting multiple furniture layouts that optimize physical and virtual factors like lighting, space utilization, and even digital feng shui principles. Sarah views these layouts overlaid in her actual living room and in her virtual environment simultaneously, allowing her to make informed decisions that enhance both her real and virtual living spaces.

With the sofa perfectly positioned in both dimensions, Sarah delves into its interactive features. Through her AR glasses, she controls various aspects of both her physical home and her virtual environment directly from her sofa. A virtual control panel materializes around the sofa in the Metaverse, enabling her to adjust lighting, play music, and manage smart home devices across both realms with intuitive gestures and voice commands. For movie nights, the AR system synchronizes settings between her physical and virtual worlds, dimming lights and adjusting surround sound to create an immersive atmosphere that reflects the genre of the movie being watched. In the next section we step through how each narrative or narratives elucidate the interaction or fit between social aspirations and technical capabilities, the reciprocal influences between these domains, and the sociometrical amalgamation that these technologies foster in educational, corporate, and entertainment settings. These narratives serve not only as demonstrations of current possibilities but also as projections of AR's evolving role in shaping future social and technical landscapes.

6 Discussion

The narratives assist in imagining possibilities of AR's evolving role in shaping the future of the Metaverse. Utilising horizon scanning, we synthesize recent technological developments to envision the potential futures that are designed as artifacts from the future. against viewing the future of IS as a linear progression from current states. Instead, our research contributes to the dialogue on how to foster and manage emerging forms of AR in the Metaverse through a "doing futures" approach Hovorka & Peter (2021). Our narratives unfold in a structured manner, progressively revealing complex dialogues about the implications of these technologies. This staged presentation aims to illuminate aspects of future interactions that might remain hidden without such a detailed exploration. Reflecting on our use of horizon scanning and narrative creation, we recognize the tension between the need for rigour and the inherent creativity of speculative futures in IS research. By maintaining transparency in our methods, we balance these demands, proposing that such futures can form a new, vital domain within academia.

These narratives inform our understanding of the sociotechnical dynamics that AR will navigate and mould within the Metaverse and, more broadly, in the real world. In the context of AR within the Metaverse, ensuring a harmonious fit between social objectives and technical capabilities is crucial. The predictive personalization of AR during the pre-purchase phase represents an advanced integration where technology adapts based on the user's emotional and physiological responses. This narrative mirrors the notion explored by Morris and Venkatesh (2010) where technology adjusts based on the user's implicit feedback, enhancing satisfaction and engagement. This adaptive technology fits within the organizational context of enhancing consumer experience, reducing the misfit that Strong and Volkoff (2010) caution against in domains where organizational objectives and technical systems might otherwise clash. This enhanced virtual experience may also translate to increased sales and customer loyalty in physical stores. Furthermore, the data gathered in these personalized pre-purchase narratives can be used to develop more accurate customer profiles, which can be leveraged to improve the entire retail experience in both virtual and real-world stores.

The reciprocal nature of interactions between social structures and technological artifacts is evident in the purchase phase narrative involving blockchain-powered AR smart contracts. Here, the technology not only supports but enhances the purchasing process by integrating secure, transparent contract management directly within the user interface. This reflects the structurational model of technology (Jones & Karsten, 2008; Orlikowski, 1992; Poole & DeSanctis, 2004) where the technology reshapes the traditional purchasing routines (a social structure) and, conversely, the existing norms of purchasing influence how the technology is used and perceived. Moreover, the adoption of blockchain in AR for smart contracts could streamline real estate and other large item purchases by offering a more transparent and secure alternative to paper-based contracts and reducing the need for third party intermediaries.

The post-purchase phase, where the AR system integrates the sofa into different aspects of Sarah's daily activities, epitomizes the sociomaterial entanglement of the social and the technical. This narrative shows how AR does not simply exist alongside social activities but becomes an intrinsic part of daily routines, influencing and enhancing personal and recreational activities. The technology and social practices evolve in tandem, demonstrating the "constitutive entanglement" described by Orlikowski (2007), where social and technical dimensions are not merely interacting but are fundamentally interwoven. This could lead to greater consumer engagement with their products, reduce waste through enhanced information access about product care, and influence the development of new products by offering insights into user behaviour.

6.1 Inscription of Social Considerations within the Technological Artifact

Throughout the narratives, social considerations such as user experience, ergonomic health, and personalized engagement are deeply inscribed within the technological artifacts. These considerations reflect the embedding of "kernel theories" from social sciences into the design of AR technologies, as suggested by Walls et al. (1992). For example, the predictive personalization uses psychological insights to enhance user satisfaction, and the ergonomic suggestions in the post-purchase phase draw upon health sciences to improve physical well-being. This design philosophy ensures that the AR technology is not only functional but also attuned to human needs and values, illustrating how technological designs can encapsulate broader social objectives. This approach not only enhances virtual experiences but also sets a standard for more human-centered design in all technological development, and demonstrates how insights into human psychology can improve the real-world experience of a product.

AR can play a significant role in the Metaverse by enhancing the user's experience and immersion in virtual environments. AR technology can be used to overlay virtual objects and information on the real world, allowing users to interact with digital content in a more natural and intuitive way (Billinghurst & Kato, 2002; Bower et al., 2014; Kesim & Ozarslan, 2012). For example, the added interactivity of augmented books makes them a strong advantage over print-only books. The book can be rotated or tilted to see the virtual content from different viewpoints, or the pages can be flipped to view different AR scenes (Billinghurst & Duenser, 2012). Our predictive personalization narrative during the pre-purchase phase, where AR adapts product designs in real-time based on user reactions, illustrates the advanced potential of AR to dynamically align with user preferences, enhancing decision-making in shopping experiences. This also has implications for physical retail stores, as businesses may utilize data from these AR interactions to design better store layouts and product displays. The predictive personalization also offers an opportunity for retail to be more ethical. By reducing product returns (and therefore waste) companies that utilise this tech are demonstrating a commitment to sustainability. This exemplifies an excellent fit between technical capabilities and social objectives, where AR technology adeptly meets user needs in a personalized manner (Interaction or Fit between the Social and the Technical).

Additionally, AR can be used to create more realistic (Wu et al., 2013) and dynamic virtual environments (Salinas & González-Mendívil, 2017), making the Metaverse more immersive and believable. Furthermore, immersive virtual environments offer real-world benefits including better training for doctors and specialists, in a safe and remote environment. In a realistic and fun environment, immersive simulations provide medical specialists and students with a great opportunity to enhance their skills and gain new experiences. Moreover, it provides a safe and effective way to train remotely.

The blockchain-powered AR smart contracts in the purchase phase represent a reciprocal interaction between social and technical systems. This technology not only secures transactions but reshapes the commercial landscape by embedding transparency and trust directly into the transactional processes, illustrating how AR technology can adapt to enhance and secure commercial practices (Reciprocal Interactions between the Social and the Technical). The implementation of such a system could simplify complex real-world purchases and transactions, including real estate and other large assets, by reducing the need for third party intermediaries. In the post-purchase phase, AR assists users in integrating and setting up their products. This narrative, where AR provides real-time ergonomic guidance, showcases the sociomaterial intertwining of AR with daily living, changing how users interact with products. By providing enhanced information about the maintenance and use of products, this type of system also extends the life of products and reduces waste. Therefore, the use of AR technology has implications for sustainability and resource management. The technology is fundamentally embedded within user activities, altering the traditional setup processes and enhancing user comfort and product usability.

AR can enhance the social aspect of the Metaverse by allowing users to interact with each other in more realistic and immersive ways (Hennig-Thurau et al., 2023). This has implications for the real world, including new opportunities for remote collaboration, the creation of more personalized and social e-learning environments, and new methods for communicating across cultural barriers. One way AR can enhance social interactions in the Metaverse is by allowing users to see and interact with each other's avatars in a more lifelike way (Hennig-Thurau et al., 2023; Kim et al., 2023; Phakamach et al., 2022). Recent advancements in AR technology have significantly improved the integration and functionality of avatars in AR experiences, enabling the overlay of photorealistic 3D avatars onto the user's view of the real world, creating more lifelike interactions that closely resemble face-to-face encounters (Buhalis et al., 2023). These avatars can be animated in real-time to mimic the user's movements and expressions, enhancing the sense of presence and immersion. The integration of artificial intelligence (AI) with AR avatars has further elevated their capabilities, enabling them to understand and respond to user interactions naturally, adapt their personalities based on context, and tailor communication styles to individual user preferences (Liu & Siau, 2023; Ramya & Ramamoorthy, 2025). This tech can also be used in the real world for remote mental health support, job interviewing and improving remote customer service by making remote interactions feel more real. Each detailed narrative underscores how AR can be thoughtfully designed to align with, enhance, and transform human interactions within various settings, providing practical examples that illustrate the profound impact of AR when integrated within a socio-technical framework. These applications highlight how AR technologies are designed with a keen adherence to enhancing user engagement and interaction, promoting a rich, integrated user experience that reflects the constitutive entanglement of social and technical elements. Furthermore, it also has the potential to positively impact real-world interactions by providing access and inclusivity to marginalised communities by allowing people to experience virtual realities and social settings that might otherwise be inaccessible.

6.2 Theoretical and practical implications

Our study provides a new perspective on the value of future-oriented AR within the Metaverse and offers rich insights into the potential role of AR. It equips industry and academia with crucial understanding and practical strategies to help shape the Metaverse.

It contributes to the Information Systems (IS) literature by addressing a significant gap in understanding how AR technologies are shaping and being shaped by social dynamics within the emerging Metaverse. Specifically, limited work combines future-oriented techniques to anticipate and explore the complex socio-technical interactions in the Metaverse with a focus on AR. Methodologically, our application of horizon scanning and narrative development is novel within the IS field and provides a structured approach for anticipating future technological and societal developments related to the Metaverse.

From a theoretical perspective, the developed narratives highlight how the Metaverse is a co-evolving sociotechnical system, aligning with structuration theory, where technology reshapes social structures and existing norms influence technology use. The narratives showcase a shift in design thinking to embrace open-mindedness and "constitutive entanglement," where technology is interwoven with social practices rather than merely interacting with them. In this context, the concept of adaptive technology, exemplified by pre-purchase personalization, can enhance user satisfaction while reducing the misfit between organizational objectives and technical systems.

From a practical and ethical perspective, we acknowledge that while these narratives demonstrate the immense potential of AR technology in the metaverse, the price component of accessing this technology cannot be ignored. Despite its immense value and the potential for social mobility and economic engagement that it may bring, the current price points of the technology may create a digital divide, making this technology inaccessible to the masses. Therefore, it is crucial that as the technology is developed, considerations are given to how wider communities may access these technologies, so this opportunity is not only accessible to the privileged.

From a managerial perspective, this study underscores the necessity of a holistic, sociotechnical approach when designing AR in the Metaverse. Organizations should carefully consider the social context and broader societal impacts alongside technical functionalities. For instance, integrating blockchain-powered smart contracts and personalized user profiles reveals practical pathways for improving retail and other customer experiences.

7 Research agenda

The future outlook of this study aims to advance the understanding of user behaviour and engagement with AR technology within the evolving landscape of the Metaverse. This research agenda emphasises exploring specific cognitive states, such as cognitive load and flow, and emotional states, such as stress and anxiety, impacted by AR, providing a foundation for designing user-centric, sustainable Metaverse environments. By employing narrative planning through a sociotechnical lens, the study underscores the imperative to architect the Metaverse in ways that harmonize individuals' and organisations' needs and aspirations. This approach calls for a paradigm shift from traditional design models that prioritize optimization towards more adaptive, emergent strategies that accommodate the fluidity and unpredictability of user experiences in the Metaverse.

Recognizing the intricate interplay between AR technology and human well-being, the proposed research agenda focuses on balancing technological advancements with the diverse dimensions of human experience, thereby promoting a more holistic development of the Metaverse. As AR continues to blur the boundaries between virtual and physical realities, fostering highly immersive and interactive environments, it introduces unprecedented complexity and potential for user engagement. In light of the Metaverse's expansive role in facilitating social interactions, economic transactions, and digital lifestyles, developing a nuanced understanding of user adoption and engagement patterns with AR technology is crucial. This understanding is key to realizing the Metaverse's potential as a space supporting technological innovation and human flourishing, ensuring its growth aligns with broader societal values and needs.

How can adaptive AR experiences in the Metaverse be designed to enhance cognitive and emotional well-being, specifically by minimizing cognitive load and maximizing flow states, and what frameworks are needed to balance immersive engagement with potential psychological risks? This research could include both controlled experiments and longitudinal studies to evaluate the efficacy of various adaptive AR strategies.

What new forms of digital economies and social contracts will emerge as AR technology in the Metaverse enables unprecedented modes of participation, creation, and exchange, and how can these developments be guided to benefit broader society? Specifically, how will value be created and distributed within these new economies, and what ethical considerations must be addressed? This could include ethnographic research, analysis of digital transactions, and comparative studies across different platforms.

In what ways will the evolution of AR interfaces within the Metaverse transform users' sense of reality, identity, and presence, specifically by examining the interplay between avatar identity and the dynamic construction of presence. and how can these transformations be aligned with the principles of digital wellness and human flourishing? This could be done by using validated scales of presence and longitudinal data, and ethnographic research, including user interviews and observations,

What technological, ethical, and regulatory challenges will arise from the convergence of AR and AI in creating fully immersive, adaptive Metaverse experiences, particularly regarding algorithmic bias and data privacy and how can cross-disciplinary collaborations address these challenges proactively?

How can AR-enhanced learning environments within the Metaverse redefine education and professional training especially by personalizing learning experiences and ensuring accessibility, and what future skills will be required to navigate and thrive in these immersive digital landscapes? This research could incorporate studies on skill transfer efficacy using performance based assessments, and a comparison with traditional learning environments.

8 Conclusion

In the context of AR and the Metaverse, AR, as a technological artifact, is not just a standalone tool; it is deeply embedded within social contexts, be it psychological, cultural, or economic (Silva et al., 2022). When users like Sarah step into the Metaverse, they don't just interact with a piece of technology; they engage in a dynamic ecosystem where technology and societal norms coalesce. The beauty of the sociotechnical perspective lies in its balanced view. It does not prioritize the technical over the social or vice versa. Instead, it acknowledges that outcomes, especially in complex environments like the Metaverse, emerge from the symbiotic relationship between the two. This is evident in how AR applications in the Metaverse can drive instrumental outcomes, such as enhancing retail experiences, while also promoting humanistic values like well-being, equality, and freedom (Mohammed et al., 2024; Singla et al., 2024).

The Metaverse's instrumental and humanistic objectives cannot be defined by conventional information systems (Seidel et al., 2022). Unlike traditional information systems that represent a real-world phenomenon or augment a physical device, the Metaverse is a confluence and integration of immersive social experiences that transcend the physical limitations of the real world (Ryskeldiev et al., 2018), and it may play a vital role in various social activities and economic transactions. Furthermore, the incorporation of AR technology within the Metaverse adds a new layer of complexity to the system, as it seamlessly blends the virtual and physical worlds (Buhalis et al., 2022), thereby creating an even more immersive and interactive experience for users (Chenna, 2023; MacCallum & Parsons, 2019). The Metaverse's design must consider the open-mindedness, emergence, and experiences that transcend established boundaries, which departs from the traditional approach of designing for optimization and convergence to a specific outcome (Dionisio et al., 2013). Future research can explore these findings, emphasizing the dynamic connection between technology, social practices, and economic realities.

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