

Leveraging the Metaverse for Sustainable Practices in Retail Business: Opportunities and Challenges

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Abstract

The rapid emergence of the Metaverse presents transformative opportunities for the retail sector, particularly in advancing sustainability across environmental, social, and economic dimensions. This paper explores how metaverse applications such as virtual stores, immersive product trials, and NFT-based commerce can promote sustainable retail practices. The primary objective is to examine the potential of the Metaverse to contribute to sustainability goals, using selected use cases that highlight its impact on reducing carbon emissions, enhancing social inclusion, and enabling cost efficiencies. A qualitative research approach is adopted, drawing on secondary data from academic literature, industry reports, and recent case studies of metaverse implementation in global retail. The analysis is structured using the Triple Bottom Line (TBL) framework to assess the sustainability impact in three domains: environmental (reduction in travel and returns), social (improved accessibility and well-being), and economic (operational savings and new streams of revenue). Findings indicate that the Metaverse can significantly reduce environmental impact through virtual shopping, support social sustainability via inclusion and employee empowerment, and enhance economic resilience through digital innovation and customer engagement. However, challenges such as digital inequality, energy consumption, and regulatory gaps remain. The study offers key implications for managers, policymakers, and researchers by proposing strategic pathways for sustainable metaverse adoption in retail. It advances theory by extending the TBL framework to immersive technologies and highlights the need for supportive digital and policy ecosystems.

Keywords: Metaverse in retail, Sustainable retail, Immersive experience, Triple bottom line sustainability.

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1. Introduction

The metaverse has been in existence for some years but it became a buzzword among the academics and business experts ever since the rebranding the Facebook Inc. as Meta Platforms Inc., signals a renewed emphasis on the advancement of virtual and augmented reality technology and the establishment of a metaverse platform. The metaverse is considered to be a new version of the internet that makes use of virtual reality (VR) device, blockchain technology and digital avatars. It is a virtual world similar to the real world for an immersive interaction with other users (Lee et al., 2021; Dwivedi et al., 2022). Business organisations are already assessing the metaverse's potential and how their current business structures can include it. Retailing is one of the main industries where the metaverse is anticipated to have an impact. Customers can explore virtual worlds in the metaverse that are modelled after actual shopping locations, but with additional levels of immersion and interactivity. (Yoo et al., 2023).

The advent of new media, information and communication technologies, the internet, and shifting customer behaviour have all had a major impact on the evolution of the retail sector over time. Modern technologies are transforming the retail environment by augmenting established formats and creating new opportunities. Before the IT era, businesses were interacting directly or indirectly with consumers in traditional, offline ways. During the onset of the IT era with web1.0, consumers were able to access websites for various information. The web2.0 enabled search engines and social media provided consumers

to engage with the brands in personalised ways. With the emergence of web3.0, the metaverse, virtual technologies, and the retail industry are set to enter a new era that is focused on active customer participation. The retailers may deliver customers 3D visual experience and improved interaction with the metaverse by effectively closing the “immersive experience” gap in the existing online commerce landscape (Papagiannidis, 2008; PwC, 2022).

Today's marketplace is very different from that of ten years ago, with new opportunities, difficulties, and marketing behaviours. The modern consumer is characterised by demand for connectivity, ease of use and customization, and more options, control and expectations than previous generations (Hagberg et al., 2016). Moreover, today's consumers are more willing to select those retailers, who are eager to implement sustainable practices (Dan-Cristian et al., 2019).

The metaverse is considered to be a digital world which can promote sustainability. It is predicted that the environmental, social, and economic sustainability would be impacted by the metaverse globally (Jauhiainen et al. 2022; Pamucar et al., 2022; Arpacı et al., 2022). Retail businesses can gain a longer-lasting competitive edge over their competitors and increase market share by developing innovative products using the metaverse to meet the evolving needs of their consumers (Abumalloh et al., 2023). Jauhiainen et al. (2022) concluded that emerging metaverse technology will support sustainable retail operations and also highlighted the potential benefits and associated challenges.

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While existing literature explores the metaverse's technological potential (Jauhiainen et al., 2022; Arpacı et al., 2022), there is a lack of focus on implications for sustainable retail. Most studies highlighted the potential rather than practical strategies and consumer responses. To bridge this gap, following research questions are framed:

RQ1: What are the opportunities of metaverse adoption in retail contributes to sustainability?

RQ2: What are the and challenges for retailers in adopting metaverse technologies and strategies to overcome them?

This study addresses the above research questions by linking metaverse adoption with sustainable practices and consumer engagement. Through use case, it has tried to demonstrate the opportunities and challenges of immersive retail experiences and sustainable business practices.

The rest of the paper is organized as follows: Section 2 details the literature review on metaverse and its application in retail. Section 3 describes methodology. Section 4 illustrates the use cases of metaverse application in retail. Section 5 presents the discussion on the sustainability benefits of metaverse adoption in retail. Section 6 discusses the metaverse adoption risk and challenges. Section 7 proposes a metaverse enabled sustainable retail model. Finally, section 8 provides conclusion and suggestions for future research.

2. Literature Review

2.1 Evolution of Retail

The retail industry has seen a shift from *product-oriented* (traditional) retailing to *customer-oriented* (electronic) retailing to experience-oriented (metaverse) retailing (Bourlakis et al., 2009; Papagiannidis & Bourlakis, 2010). The shift was to serve the today's consumer characterized by being always connected, seeking convenience and personalization, and having higher expectations, more control and choices than ever before (Bourlakis et al., 2009; Hagberg et al., 2016; Weuthen, 2019; Backhaus & Paulsen, 2020).

Product-oriented retailers aim to develop offerings that meet customer needs and focus on selling the most profitable items based on past customer profitability, overlooking future value (Gupta & Ramachandran, 2021). They enhance consumer confidence through sensory experiences like smell and touch but face issues such as stock management, long queues, high costs, and limited hours (Bourlakis et al., 2009; Gauri et al., 2021).

Retailers gradually shifted to a customer-oriented strategy, aiming to build relationships and deliver the right product at the right time. Technology drove this shift, with e-retailers like Amazon—selling its first book online in 1995—leading the change (Feinberg & Kadam, 2002). E-retailing, defined as selling goods and services online for personal use emphasizes data over physical assets. By analyzing consumer data, online retailers offer personalized experiences. They also benefit from lower costs, broader selection, convenience, and 24/7 global reach. However, they face challenges like timely delivery, security risks, fast-paced innovation, performance tracking, and creating a compelling digital atmosphere.

While traditional retail offers atmospherics and social interaction, online channels excel in accessibility and variety but lack immersive experiences. To bridge this gap, e-retailers can adopt an experience-oriented strategy, catering to consumers seeking memorable and engaging interactions. The metaverse enables such experiences by creating immersive virtual environments (Papagiannidis & Bourlakis, 2010). Here, the focus shifts from product delivery to enhancing the customer journey through emotional, cognitive, and social engagement (Lemon & Verhoef, 2016). Virtual stores let users explore, interact, and shop like in real life—without physical limits—offering retailers new ways to enrich shopping creatively and collaboratively (Papagiannidis, 2008).

2.2 The Metaverse and related technologies

The metaverse, still in its early stages, lacks a standardized definition due to its multidisciplinary nature and evolving technologies. Broadly, it refers to a virtual world resembling the real one, enabling user interaction through digital avatars (Dwivedi et al., 2022). More specifically, it is a fully immersive, computer-generated 3D environment where avatars engage in real-time activities like socializing, shopping, working, or gaming, free from physical constraints (Dionisio et al., 2013; Lee et al., 2021). These virtual spaces may mirror reality or feature fictional worlds with extraordinary capabilities (Yang et al., 2022).

The key technologies that form the foundation of the metaverse are networking, cloud computing, artificial intelligence (AI), blockchain, extended reality (XR), Internet of Things (IoT), and digital twins. The metaverse has grown rapidly due to significant improvements in these technologies in the last few years. In particular, the combination of these technologies presents a wide range of novel applications and helps to shape the metaverse (Lee et al., 2021; Wang et al., 2022). Technology enablers of metaverse are shown in Table 1.

Table 1: Technology Enablers of Metaverse

Technology	Role in the Metaverse
Augmented Reality (AR), Virtual Reality (VR), and Extended Reality (XR)	Help create immersive and engaging three dimensional environments for the metaverse.
Blockchain technology	It provides a decentralization and transparency and security that is necessary for the functioning of the metaverse. Helps create Non-Fungible Tokens (NFTs), cryptocurrency, sell and purchase of NFTs etc.
Artificial Intelligence	Create realistic avatars, Make conversation and actions more realistic-human like.
5G and Edge Computing	Enable individuals to interact in real-time without any time lag in metaverse and provide a truly immersive experience.

In the short to medium term, metaverse initiatives are likely to emerge in isolation, but in the long run, it is envisioned as a vast network of interconnected virtual worlds beyond current technological limits, with the potential to transform all industries and aspects of life (Dionisio et al., 2013; Di Pietro & Cresci, 2021). Gartner (2022) views the metaverse in its early stage, expecting full maturity by 2030. Its future appears promising, and estimated to generate up to \$5 trillion in value by 2030 (McKinsey, 2022).

2.3 Sustainability in Retail

Sustainability has gained significant attention in business and marketing, as it can attract consumers (Marín-García et al., 2020; ADD). In retail, growing pressure from consumers, investors, and regulators has made sustainable practices increasingly vital (Jones, Hillier & Comfort, 2014). It offers a competitive edge by appealing to environmentally and socially conscious consumers (Rodríguez-Rad & Ramos-Hidalgo, 2018; Watson et al., 2020). Retailers are now expected to deliver efficiently while minimizing environmental and social impact.

While research on sustainability in retail is growing (Ruiz-Real et al., 2018), limited studies explore the metaverse's role in retail sustainability (Gadalla et al., 2013; Abumalloh et al., 2024; Jauhiainen et al., 2022). This is despite its broader application to sustainability in sectors like education, tourism, and manufacturing (Wu et al., 2024; Ertz et al., 2024; Kılıçarslan et al., 2025). The metaverse is seen as a digital platform to advance environmental, social, and economic sustainability (Pamucar et al., 2022; Arpacı et al., 2022). However, some argue it may harm the environment due to blockchain's high energy use, though greener technologies like proof-of-stake are emerging (Townsend, 2022). Metaverse may harm the environment as cryptocurrencies and NFTs use blockchain technology, which consumes a significant amount of energy. However, a major shift toward sustainability is emerging, with less energy-intensive 'proof of stake' chains (Townsend, 2022).

Gadalla et al. (2013) developed a framework to help retailers enhance service quality in 3D metaverse stores. Abumalloh et al. (2023) examined factors influencing metaverse adoption and its role in achieving sustainable competitive advantage in retail. The study found that sustainability awareness significantly impacts adoption and that

innovative metaverse-focused products can meet the changing customer demands, boost market share and long-term competitiveness. Jauhiainen et al. (2022) also noted that metaverse technologies can support sustainable retail, while highlighting both their potential benefits and challenges.

A review of existing literature reveals a clear gap in research on the metaverse's role in advancing sustainability within the retail sector. Specifically, there is a lack of studies that explain how retailers can leverage the metaverse to promote environmental, social, and economic sustainability in their operations.

2.4 Metaverse Applications in Retail

2.4.1 Metaverse Enabled Virtual Stores and Goods

Retailers can set up Virtual 3D stores providing virtual shopping environments within the metaverse that replicate physical retail experience. These stores offering virtual products replicating physical products on shelves can be opened within the metaverse that offer immersive and interactive shopping experiences. Virtual stores can replicate the physical retail experience, allowing consumers to navigate through virtual aisles, visually examine products, read descriptions, and make purchases in a visually immersive setting (Dwivedi et al., 2022).

Customers can enter the virtual store through their digital avatars and can explore and interact with virtual products placed on virtual shelves, as well as try on virtual clothing or accessories. The virtual shopping environment can offer a better engaging and interactive, social experience as compared to traditional online shopping interfaces. This avatar-based shopping adds a social element to the online retailing experience, allowing users to engage with other avatars and share their shopping experiences and thus can bridge the gap between online and offline retailing. These social interactions can greatly benefit a business and add value to other customers' experiences (Papa-geannidis, 2008).

The creation of virtual stores by online retailers can create unique experiences along their customers' journey. Because modern consumers like to use goods and services rather than just consume them. For organizations, managing the client experience has become essential.

Customer experience is defined as “customer’s cognitive, emotional, behavioral, sensorial, and social responses to a firm’s offerings during the customer’s entire purchase journey” (Lemon & Verhoef, 2016, p. 71). Leading luxury brands including Nike, Louis Vuitton, Gucci etc. have invested significantly in the metaverse and have set up their virtual storefronts to sell their virtual products as NFTs to consumers to dress up their avatars. Nike and Adidas have a strong metaverse strategy to sell virtual sneakers and apparels as NFTs (Dwivedi, 2022).

Research suggests that users will be accessing virtual worlds using their avatars for longer periods of time. They will want their avatars to be just as stylish and representative of our unique personalities and styles as they are in the real world. Today’s digital natives spend more time in virtual environments, such as social media and virtual reality, which has led to the creation of multiverse identities in them and new patterns of consumption to support those identities (Joy et al., 2022).

Looking at the potential of the metaverse, few brands are also focusing on selling real, physical products in the metaverse. Global brands Wendy’s and McDonald’s are now focusing on linking their physical outlet with an aim of creating synergies. Wendy’s, a global fast-food chain headquartered in the US, has introduced the “Wendyverse” - a virtual hangout spot in Meta’s ‘Horizon Worlds’ where its customers can interact with the brand. In addition to playing mini-games and social interactions, customers can select items for pickup or delivery from their nearest Wendy’s location in real life (PR Newswire, 2022). McDonald’s has filed trademark applications for virtual eateries as well as virtual food and drink items. Customers can place orders in a virtual McDonald’s restaurant while they’re idling around the metaverse, and those orders will be delivered to their homes in the real world. (Lucatch, 2022).

Presently most of the products sold on metaverse tend to be hedonic, that is only for pleasure. It makes sense as people choose traditional internet shopping for faster and more convenient ordering of utilitarian products, which are frequently ordered (Dwivedi, 2022). It will take some time, when large number of customers would start buying physical products on metaverse store.

2.4.2 Metaverse Enabled Virtual Try-Ons

Customers find choosing an outfit size to be an extremely difficult procedure, particularly when shopping online. Due to size and fit issues, a higher return rate has been seen in online apparel shopping, which raises operating expenses significantly. (Abdulla et al., 2019). The proportion of product returns was 17% of goods sold, costing \$218 billion in 2021 as reported in Forbes (Marr, 2022). Retailers in the metaverse can design “virtual dressing rooms”. Customers through avatars can virtually try on as many apparel items from the retailer’s inventory as they desire. Users have the ability to view the product from any angle and position and place the avatar in a variety of settings such as offices, nightclubs, and beaches. Customers may choose proper products easily and make better buying decisions, which would reduce the product returns (Marr, 2022).

In addition to making easy for customers to try on items, virtual tools like virtual, augmented, and mixed reality helps to improve their shopping experiences by assisting to find right size fit (Idrees et al., 2023; Voicu et al., 2023). These interactive tools are similar or different as how they provide virtual fitting room experience that is accurate, attractive, interactive, and immersive for fashion using extended reality tools along with body measurements and customised avatar acquired from scanning apps. These scanning apps are able to detect the user’s facial as well as body shape and provide 3D output facilitating 360-degree viewing (Kim & Sung, 2021). The consumers found 3D body scanning useful for acquiring body dimensions for receiving recommendations for customised and sizes (Idrees et al., 2020). This provides rich visual information and sensory engagement about objects in the fashion metaverse. This helps customers to view size and fit before any purchase (Idrees et al., 2023).

2.4.3 Metaverse Enabled Marketing Communication and Customer Engagement

Marketing communications are the ways firms inform, persuade, and remind customers about their products and brands, helping to build relationships. The communication mix includes tools like advertising, public relations, personal selling, sales promotion, events, direct marketing, and online marketing to reach target audiences.

There are huge opportunities in the metaverse in terms of marketing communication or brand promotion in an immersive environment. In addition to allowing brands, a set of new and exciting avenues to market their products and value proposition, the metaverse offers a plethora of opportunities to increase customer engagement (Barrera & Shah, 2023). It allows marketers to reach out to their distinguished customers worldwide. Previous research found positive impact of latest interactive media presentation modes such as VR and AR on consumers’ responses.

Advertising is an element of marketing communication in which a company informs and persuades its customers about its brands. Advertising methods in real world can be applied in the metaverse, where customers can get engaged and even interact with animated characters in 3D billboards advertisements on virtual roadways. In case a contest is used for promotion, individuals have the opportunity to virtually participate. Consumers will take pleasure in this form of advertising in a completely immersive environment (Bansal et al., 2023). Rather than merely having static picture billboards, the metaverse platforms offer video ads. Digital billboards, which display personalized advertisements to the avatars based on their previous digital footprints and behaviours. (Dwivedi et al., 2022).

The unique interactivity element of Metaverse engages users and gives them the freedom to choose based on their expectations. This adds to the fun and memorability of shopping. The task for businesses will be to create non-intrusive advertisements that convey enough information to let consumers make an informed choice (Kraus et al., 2022). Companies can also have their avatars as representatives to interact with a large number of customers with personalised attention, something that is not feasible in the real world. This is similar to personal selling component in the marketing communication-mix.

Metaverse offers a huge opportunity to connect with and engage customers using 'events and experiences' element of marketing communication. The immersive feature of metaverse environment provides utilitarian as well as hedonic benefits and high degree of augmentation to encourage customers change their attitudes in favour of brands (Rauschnabel et al., 2019). There would be an opportunity for companies to sponsor live events like concerts, sports etc. in metaverse as these events will be transmitted for different target segments (Dwivedi et al., 2022). Moreover, metaverse has a tremendous capability to read audiences' psychological reactions while they navigate the digital world. Neuromarketing technique can be used for examining customer cognitive behaviour and emotional responses. With the help of this technique, marketers can focus on conscious as well as unconscious mental activity when users search for product information. It will help a marketer build strong relationship between a brand and its customers (Karmakar & Yoon, 2016).

2.4.4 Metaverse Enabled Employee Training

The metaverse can be used by companies for providing virtual training and educational experiences to employees as well as customers, thereby reducing the need for physical training facilities. This can improve employee skills and knowledge economically and make education more accessible to a wider audience. The reviews of previous research indicate that immersive training in metaverse has a lot of potential and bright future benefits for both employees and employers (Upadhyay and Khandelwal, 2022). Onu et al. (2023) conducted qualitative research to examine the effect of Metaverse on teaching and learning by analysing its benefits and challenges. The results highlight how Metaverse's immersive and interactive features make it an amazing tool for personalized and adaptable learning. Metaverse can create immersive learning experiences in which students can explore as well as interact within customized virtual environments. Virtual reality (VR), which is one of several ways to enter the metaverse, is getting more popular for providing training to develop hard as well as soft skills like communication, leadership, resilience and managing through change.

3. Methodology

This study is a qualitative and exploratory research to understand the potential of Metaverse technologies in promoting sustainability within the retail sector. The research is grounded in secondary data analysis, drawing from peer-reviewed academic literature, industry reports, white papers, and documented case studies published between 2016 and 2025. Use cases were selected based on their relevance to sustainability goals and their demonstration of practical applications of Metaverse tools in retail operations. The selected cases covers diverse geographies and different dimensions of Metaverse integration, including virtual product trials, immersive shopping environments, NFT-based transactions, and virtual employee training. The Triple Bottom Line (TBL) framework was employed to analyse use cases into environmental, social, and economic sustainability benefits. Thematic analysis was used to identify opportunities, benefits, and challenges in each domain, enabling a structured evaluation of how Metaverse adoption supports sustainable retail transformation.

Although the insights are based on well-documented cases, the study is limited by its reliance on secondary data and the absence of empirical testing, which future research could address.

Recent literature highlights several applications of the metaverse in retail, showcasing its potential to deliver immersive customer experiences while supporting sustainable business practices. Key areas include Metaverse-enabled virtual stores and products, virtual try-ons, marketing communication and customer engagement, and employee training. These applications will be illustrated through relevant use cases.

4. Use Cases of Metaverse in Retail

4.2 Metaverse Enabled Virtual Stores and Goods

Global brands such as Nike, Walmart, Forever 21, and McDonald's are actively exploring product sales through virtual stores in the metaverse. Fashion brands like Nike and Forever 21 have already launched virtual shops—'Nikeland' and 'Forever 21 Shop City'—on the Roblox platform, allowing users to try on and purchase virtual products for their avatars while engaging in online gameplay.

Use Case 1: Global fashion brand Forever 21 in 2021 launched a virtual retail setup 'Forever 21 Shop City', in Roblox metaverse platform. Customers can purchase virtual apparel for their avatars in Shop City. A year later, Forever 21 Shop City unveiled its first-ever fashion line inspired by the metaverse to commemorate its one-year "Meta-versary." After the brand's virtual product testing proved successful, the F21 Metaverse Collection was made available both in-store and online at www.forever21.com. It has included t-shirts and hoodies created with components from the brand's virtual products in addition to real-life version of the popular Forever Beanie, the best-selling item in Forever 21 Shop City on Roblox. After the success of virtual Forever Beanie in the Roblox stores, the firm bought the complete F21 Metaverse collection in physical stores and its website, www.orever21.com, with products starting at \$14.99 (Business Wire, 2022).

Use Case 2: American retail giant Walmart is gearing up to "reinvent retail" via the metaverse by allowing customers to purchase physical versions of the items they buy virtually in their favourite mobile games, like House Flip. Customers can also purchase virtual clothing items from Walmart's fashion brand Scoop in the mobile game Zepto, a virtual world that lets players create and customize their avatars. Within the first month of launch, the retailer saw increased user engagement and purchases of virtual clothing items. (Kang, 2023).

The use cases above demonstrate how the metaverse enables all customers including those with physical disabilities to access lifelike retail experiences from home. This reduces the need for transportation and physical store operations, contributing to both environmental and social sustainability. Additionally, the metaverse allows retailers to establish new channels for selling both digital and physical products, creating additional revenue streams and enhancing economic sustainability.

4.2 Metaverse Enabled Virtual Try-Ons

Use Case 1: Leading global fashion brand, Nike have set up their virtual showroom called 'Nikeland' offering virtual versions of their real-world products and even selling limited-edition virtual NFTs. 'Nikeland', consists of a virtual store and mini-games on the Roblox metaverse platform to connect with its young consumers through gamification. Players can try on various dresses on their avatars and dress up them with Nike-branded footwears, apparels and backpacks while competing in mini-games. The metaverse initiative by Nike received a good response, with millions of people exploring Nikeland. It is a pioneer fashion brand that sold some rare pairs of virtual sneakers for more than \$80,000 in the metaverse market. It clocked a record over 67,000-plus NFT transactions and an impressive \$185 million (Bhattacharya, 2022).

Use Case 2: Walmart has introduced a virtual fitting room (using AR/VR technologies used in metaverse) on its website to boost clothing sales amid consumer cutbacks on discretionary spending. Leveraging its acquisition of Zeekit, Walmart's "Be Your Own Model" feature uses algorithms and machine learning to allow users to try on over 270,000 items virtually, using either their own images or diverse models. The tool enhances shopper confidence by showing realistic fabric draping and fit. Early data shows improved engagement and conversion (Repko, 2022).

The above cases illustrate how the metaverse allows retailers to create virtual trial rooms, enabling customers to visualize how products appear on their digital avatars. This helps reduce product returns, thereby lowering transportation needs and associated carbon emissions and thus contributing to environmental and social sustainability. Additionally, fewer returns translate into significant cost savings for retailers, enhancing economic sustainability.

4.3 Metaverse Enabled Marketing Communication and Customer Engagement

Major retailing brands like Wendy's, Domino's, Amazon etc. have created events and experiences to connect with and engage their Gen Z customers.

Use Case 1: The global fast-food chain *Wendy's* has already introduced the "*Wendyverse*" - a virtual 3D hangout spot (a replica of the offline restaurant) in Meta's 'Horizon Worlds' metaverse, where its customers can hang out with friends, play a variety of mini-games, and participate in live concerts in collaboration with iHeart Radio. Users can explore the '*Wendyverse*' world with their avatars through Meta's Quest VR headset and virtually interact with each other and the brand. They can go behind the counter, meet up with friends and get ready for a mouth-watering adventure, only virtually. They can also enter *Wendyverse Partnership Plaza*, where they can play games like cheese burger shuffle board or basketball game and score points. With this one can get a Sausage or Bacon, Egg & Cheese Biscuit for just a buck (\$1) In-Real Life in-app or in-restaurant for a certain period. It is a wonderful way to engage with the customers with gamification. (PR Newswire, 2022).

Use Case 2: Hennes & Mauritz AB (H&M) opened its first-ever virtual showroom in the metaverse platform to showcase its collections. In Jan 2023, it partnered with online game platform, Roblox to create an immersive experience through games that allowed players to play with materials and patterns to create their own clothes and wardrobes for their avatar. The goal was to connect with consumers and engage them with the products offered (H&M Group, 2023).

The above use cases illustrate how metaverse enables retailers for customer engagement and entertainment in an immersive manner leading to social sustainability.

4.4 Metaverse Enabled Employee Training

Leading businesses like Walmart and L'Oréal are already using Metaverse for training employees.

Use Case 1: Leading retailer *Walmart* is using the metaverse to train employees on how to handle commotion when shoppers flood the retail stores on special days like Black Friday and assessing how they respond to angry and unfriendly shoppers. Virtual Reality is being used to identify the employees with the necessary skills to qualify middle management levels (Lewis, 2019).

Use Case 2: *L'Oréal* is also using the metaverse to train its beauty advisors on how to apply makeup and skincare products. Beauty advisors can practice on virtual customers in a variety of different settings.

The above cases illustrate how metaverse enables enhanced employee empowerment as the organisations can provide real-life training aimed at enhancing knowledge and skills leading to social sustainability.

A summary of key use cases of metaverse in retail business is mentioned in Table 2.

Table 2: Summary of Key use cases of metaverse in retail business

Company/brand	Use of metaverse
Nike, Forever 21	Virtual showroom, Virtual try on avatars, Selling virtual products for avatars, Customer engagement with mini-games
Wendy's and McDonald's	A virtual restaurant and hangout spot where customers can play mini-games and go interact with other customers. Customers can also select items for pickup or delivery from their nearest Wendy's location in real life, Sales promotion
Walmart	Customer engagement with games, employee training, Selling virtual products
Hennes & Mauritz AB (H&M)	Virtual showroom to showcase its collections, Customer engagement with games

Discussion

As demonstrated in the use cases above, the metaverse holds strong potential to support social, environmental, and economic sustainability in retail. It can influence material use and global sustainability practices (Tozzi, 2022) while enabling retailers to meet changing consumer demands, grow market share, and gain a lasting competitive edge (Abumalloh et al., 2023).

5.1 Environmental Sustainability

The metaverse can advance sustainability by minimizing waste and energy use typically associated with traditional prototyping and production processes. By offering digital products and virtual experiences, it reduces resource consumption and improves carbon efficiency (Vishkaei, 2022). Virtual stores, or digital twins, replicate the in-store shopping experience—allowing users to explore aisles, view products, and make purchases through their avatars—without the need for physical travel (Dwivedi et al., 2022). These virtual alternatives help cut fuel use and emissions, promoting a cleaner, more efficient approach to everyday retail activities.

Previous studies emphasize the environmental advantages of virtual alternatives to traditional transport. The metaverse significantly reduces carbon emissions by enabling virtual meetings, remote work, and digital simulations, replacing fuel-heavy business travel (Lo et al., 2024). Online communication, shopping, and learning also lower energy use and reduce emissions from transportation and office maintenance (Xie et al., 2017). Sáiz and Yonge (2022) estimate that digital twins can cut building emissions by 50%, boost productivity by 20%, and improve operational efficiency by 35%. In the metaverse, customers can virtually try on apparel using avatars, viewing items from various angles and settings—an experience lacking in traditional platforms like Flipkart or Amazon. This helps reduce product returns, which made up 17% of sales in 2021 and cost \$218 billion (Marr, 2022), thereby lowering reverse logistics emissions. Brands like Nike and Adidas are already leveraging the metaverse to offer virtual products and personalized avatar experiences (Dwivedi et al., 2022).

5.2 Social Sustainability

Social sustainability in business focuses on addressing issues like social justice, equity, community development, resilience, health, and labor rights (Yugendar, 2014). In retail, the metaverse can support social sustainability by enhancing inclusion and accessibility. It allows retailers to create virtual shopping environments accessible to all, regardless of location or physical ability. Users can explore virtual aisles, inspect products, and make purchases in immersive settings (Dwivedi et al., 2022). Offering more interactive experiences than traditional e-commerce, the metaverse enables broader participation—including individuals with disabilities or in remote areas—thereby promoting equal access to goods and services (Yoo et al., 2023).

Retailers can use the metaverse to create interactive spaces where customers connect, attend events, play games, and share experiences. These interactions foster trust, loyalty, and a sense of community, strengthening brand relationships and promoting social sustainability through inclusion and shared identity. Shopping in the metaverse is often a hedonic activity, tied to enjoyment, socializing, and well-being (Ahn et al., 2024; Bloomberg, 2022). Research shows that social engagement enhances health and reduces mortality (Umberson & Karas, 2010; Acosta-González & Marcenaro-Gutiérrez, 2021).

Metaverse benefits to communities are supported by findings from Arpaci et al. (2022). To effectively integrate the metaverse, retailers

should invest in employee and user training. Metaverse allows for operational, technical, and soft skills development of employees regardless of location.

5.3 Economic Sustainability

Metaverse applications offer significant opportunities to enhance economic sustainability in the retail sector by supporting long-term growth, resilience, and prosperity for businesses, workers, and communities. The metaverse introduces new revenue streams beyond traditional retail by offering immersive virtual experiences that boost customer engagement and sales (Dwivedi et al., 2022; Barrera & Shah, 2023; Hazan et al., 2022). Companies can establish virtual stores to sell both physical and digital goods, creating novel purchasing experiences and motivations. Through NFTs, customers can try on virtual apparel, accessories, or home décor via avatars in a fully digital environment (Joy et al., 2022). The virtual market creates new demand without the cannibalization issues often seen in e-commerce, which can lead to internal competition and friction. In the metaverse, brands can design products and experiences unconstrained by physical limitations, enabling them to diversify revenue streams, build resilient business models, and adapt to evolving market conditions. One major challenge in traditional online retail is high product return rates—17% of all sales in 2021, costing \$218 billion (Marr, 2022). The metaverse addresses this through virtual dressing rooms, where customers can try on apparel using avatars. These tools, powered by virtual, augmented, and mixed reality, enhance convenience and engagement—making the shopping experience more enjoyable and effective for 34% of consumers (Kunst, 2019; Johnson, 2021). With improved customer insights, retailers can offer better recommendations and significantly reduce returns, improving overall economic sustainability (Idrees et al., 2023).

5.4 Metaverse Adoption Risk and Challenges in Retail

The metaverse presents both opportunities and challenges for companies, employees, consumers, and governments. Though it enables innovative experiences and new business models, it also introduces new types of risks and challenges due to its reliance on emerging technologies such as consumer privacy, identity theft, cybercrime, invasive advertising, and misinformation (Dwivedi et al., 2023). Users are particularly concerned about safety, bullying, and data protection (Wiederhold, 2022), while large-scale data collection raises serious concerns about privacy and security (Di Pietro & Cresci, 2021; Wang et al., 2022).

Privacy and Data Concerns: Metaverse devices can collect extensive personal data—far beyond what current Web 2.0 platforms gather. This includes biometric data, psychological responses, location, and even brainwave patterns. XR technologies, such as AR glasses, continuously track movements like eye and body gestures, raising privacy issues not just for users but also for those around them (Rauschnabel et al., 2018; Winkler et al., 2022). Such deep tracking can compromise privacy during data transmission, processing, and storage.

Psychological and Social Risks: Blending various technologies, platforms, and user groups within a single virtual space can lead to unpredictable and harmful outcomes. Risks include cyberbullying,

stalking, mental health issues, and online disinhibition, which may promote deviant behaviors (Cheung et al., 2021; Di Pietro & Cresci, 2021). These factors may discourage consumers from engaging or shopping in the metaverse.

Addiction and Cognitive Dissonance: Another concern is the potential for user addiction and post-purchase dissonance, particularly with virtual products. The metaverse leverages behavioral psychology to increase user engagement, which can distort reality and influence perceptions. As users rationalize their purchases in a constantly shifting digital space, the difficulty in aligning behavior and perception could lead to psychological strain and emerging mental health challenges (Barreda-Ángeles & Hartmann, 2022; Gordon, 2022).

Interoperability and Technical Challenges: Metaverse interoperability—essential for seamless user experiences and wider brand reach—remains a major hurdle. Current developments are mostly vendor-specific and fragmented, limiting user access across platforms (Dwivedi et al., 2023). Most metaverse platforms, like Meta's Horizon Worlds, still have limited user bases, making it difficult for retailers to scale their presence effectively.

Lack of Standards and High Costs: The absence of universal ethical, legal, and technical standards creates further uncertainty. A well-defined framework is needed to ensure safety, fairness, and inclusivity in virtual environments (Sáiz & Yonge, 2022). Additionally, the high cost of VR devices and consumer hesitation due to unfamiliarity or perceived complexity are major adoption barriers (Khatri et al., 2022). Retailers must carefully assess these risks before committing to metaverse ventures.

5.5 Strategies to Overcome Metaverse Adoption Challenges

Organisations wanting to adopt the Metaverse in retail successfully, they should implement a combination of technological safeguards, policy alignment, and stakeholder education to mitigate the risk and challenges.

Retailers should adopt privacy-by-design principles during the development of virtual experiences and ensure transparency in data collection practices to address privacy and data security risks. This involves anonymizing sensitive user data, using end-to-end encryption, and implementing opt-in consent mechanisms for XR devices (Winkler et al., 2022; Rauschnabel et al., 2018). Organisations should partner with cybersecurity firms to develop secure infrastructure and comply with regulations such as EU's GDPR (General Data Protection Regulation and India's DPDP Act (Digital Personal Data Protection Act) which can enhance user trust (Wang et al., 2022).

Metaverse platform providers and retailers must incorporate moderation tools, community guidelines, and AI-driven content filtering to mitigate psychological and social risks, such as cyberbullying and disinhibition. Creating safe virtual environments with avatar-based reporting systems, user block features, and digital literacy campaigns can empower users and foster respectful behavior (Cheung et al., 2021; Wiederhold, 2022).

Retailers should promote responsible engagement design, such as time-out prompts, gamified wellness features, and ethical UX practices that avoid manipulative mechanics to mitigate the risks of addiction and cognitive dissonance (Gordon, 2022). Platforms should also provide disclaimers or post-purchase support for digital goods, improving decision satisfaction and emotional well-being.

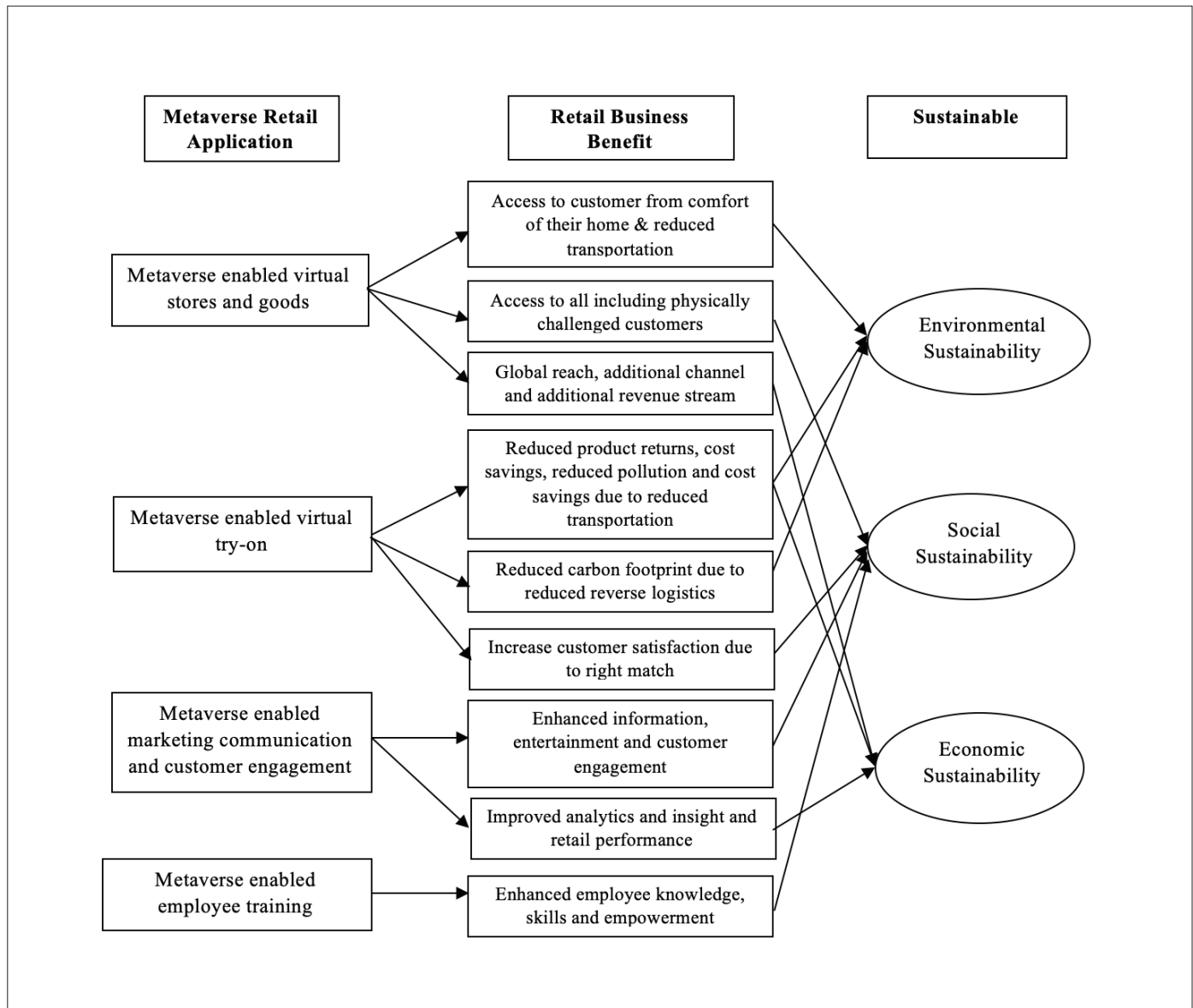
Industry players should collaborate to develop open standards and cross-platform compatibility through consortiums like the Metaverse Standards Forum to overcome interoperability and technical fragmentation. Retailers are advised to avoid platform lock-in and opt for modular, scalable architectures that ensure their content is accessible across multiple environments (Dwivedi et al., 2023).

Addressing standardization and cost issues, government incentives and public-private partnerships can help subsidize hardware for consumers and encourage ethical development. Retailers should pilot metaverse initiatives in targeted demographics while educating customers and employees to reduce technology resistance (Khatri et al., 2022; Sáiz & Yonge, 2022). Establishing governance protocols with clear ethical codes and user rights will further build institutional credibility.

In essence, a multi-stakeholder approach involving policy makers, technology providers, retailers, and users is vital to build a safe, inclusive, and sustainable metaverse retail ecosystem.

5.6 Proposed Metaverse Enable Sustainable Retail Model

A proposed model of metaverse application for sustainable retail is shown in Figure 1. Retail managers will find it useful to implement in order to improve customer immersive experience and satisfaction, and retailing sustainability. The model shows how retailers can leverage metaverse for achieving all the three dimensions of sustainability. Retail businesses, both offline and online, can utilise metaverse to reap benefits that lead to environmental, social and economic sustainability.

Figure 1: Proposed model of metaverse application for sustainable retail

The Metaverse allows retailers to create virtual 3D stores that simulate physical shopping experiences, reducing the need for travel and thus lowering carbon emissions (Xie et al., 2017; Sáiz & Yonge, 2022; Dwivedi et al., 2022). Shoppers can try products virtually, helping them make better choices and decreasing product returns, which also minimizes reverse logistics emissions (Dwivedi et al., 2022; Idrees et al., 2023; Marr, 2022). Additionally, virtual meetings and remote workspaces supported by the Metaverse help cut emissions from business travel (Lo et al., 2024). Overall, Metaverse adoption in retail supports environmental sustainability through reduced travel, logistics, and operations.

The Metaverse enables inclusive virtual shopping, accessible to people in remote areas or with disabilities (Dwivedi et al., 2022). It fosters social interaction through shared spaces for events, games, and experiences, enhancing social cohesion and well-being (Ahn et al., 2024;

Bloomberg, 2022). Studies link social engagement to improved health and lower mortality (Umberson & Karas, 2010; Acosta-González & Marcenaro-Gutiérrez, 2021). Retailers can also use it for remote employee training, promoting skill development in a low-risk, immersive environment. Thus, Metaverse use in retail supports social sustainability through inclusion, engagement, and empowerment.

The Metaverse boosts retail's economic sustainability by creating new revenue streams through virtual stores and NFT sales, offering customers more choices (Dwivedi et al., 2022; Barrera & Shah, 2023; Hazan et al., 2022). It generates demand of virtual products and reduces costs by lowering product returns through better virtual try-ons (Dwivedi et al., 2022; Marr, 2022). Retailers also gain customer insights to improve recommendations and reduce returns (Idrees et al., 2023). Overall, the Metaverse enhances global reach, revenue, and cost efficiency.

5.7 Implications

5.7.1 Implication for Research

This study advances theory by integrating immersive technologies into the sustainable retail discourse, extending the Triple Bottom Line framework to account for digital immersion and proposing a socio-technical model where metaverse applications enhance environmental, social, and economic outcomes. By articulating new pathways through which metaverse technologies contribute to sustainable development, the paper lays the groundwork for future empirical and conceptual explorations in digital sustainability.

5.7.2 Implication for Managers

Virtual stores, digital twins, and virtual products can improve purchase accuracy, reduce dissatisfaction, returns, and logistics costs, and support environmental, social, and economic sustainability. The sale of virtual products and NFTs offers new monetization avenues.

5.7.3 Policy Implication

Policy frameworks can offer tax incentives, grants, or green innovation credits to retailers adopting Metaverse solutions that demonstrably reduce carbon emissions, waste, or reverse logistics. There is a need for standardized guidelines to measure the environmental impact of virtual retail activities (e.g., energy consumption of virtual stores, reduction in physical returns). Policymakers should assess and regulate the energy use of data centers, blockchain technologies (e.g., NFTs), and immersive retail platforms to ensure digital sustainability aligns with national climate goals.

6. Conclusion and Future Research

This study highlights the transformative potential of the metaverse in advancing environmental, social, and economic sustainability in the retail sector. By integrating technologies such as VR, AR, and NFTs, the metaverse offers immersive customer experiences, improved operational efficiency, and innovative employee training solutions. These capabilities extend beyond traditional digitization by enabling a hybrid retail environment that bridges physical and virtual spaces. The findings extend existing theories like the Technology–Organization–Environment (TOE) framework and the TBL by illustrating how immersive technologies can support sustainable value creation. The study also reframes omni-channel strategies by emphasizing virtual co-presence and experiential retail as key drivers of future competitiveness. Practically, the metaverse offers new business models and customer engagement strategies, but also raises policy concerns around privacy, regulation, and digital inclusion. Managers must balance innovation with ethical and legal considerations to build trust and drive adoption. However, the study's conceptual nature and reliance on secondary data limit its validity. Future research should use quantitative and longitudinal methods to examine the real-world impact of metaverse adoption on retail performance, customer behavior, and sustainability outcomes. Cross-industry and cross-cultural studies can further explore adoption and its challenges.

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