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Exploring Metaverse from Designing Sustainable Future Perspective

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Abstract: The metaverse as a global platform has the potential to meet the SDGs by addressing the issues related to sustainability. Presently, sustainability is considered in a very narrow environment aspect, whereas, it has been established that sustainability is an amalgamation of socio-economic and environment dimensions. The extant literature posits that the emergence of metaverse will have profound impact on the ecosystem. The present paper asserts that metaverse will have large and significant future socio-economic impact along with being pro-environment by saving energy and reducing carbon emissions. However, in order to achieve the SDGs, the metaverse designers should integrate sustainability and responsibility into the design, construction, and development of the metaverse and related research. The paper discusses the visualization techniques, AR, VR & MR for immersive experiences in Metaverse. Further, the paper analyses the impact of metaverse in retail, gaming and tourism-hospitality industries on achieving sustainable future through inclusive design practices within metaverse ecosystem.

Keywords: Metaverse, sustainability, design thinking, customer experience

1. Introduction

Globally, the ecological system is facing constant environmental threats in the form of global warming, evidenced by the average land temperature being higher by 1.59·C in 2011-2020 than in 1850-1900 (Song et al., 2022), overexploitation of natural resources, a high degree of industrialization, rapid urbanisation, and high pollution levels. Climate changes, increasing Greenhouse Gas (GHG) emissions, super cyclones, increasing sea level (Fredrikse et al., 2020) up to 3.7mm per year from 2006-2018. An estimated 91% of the world's population breathes air worse than prescribed by WHO for a healthy life (Kumar et al., 2021). A study by Fuller et al., (2022) estimates that worldwide, 1 out of 5 deaths is caused by air pollution. Bastien-Olvera and Moore (2021) have calculated the non-economic damages to ecosystems due to global warming to be approximately USD 190 trillion by 2050.

Oberle et al. (2019) showcased that the amount of ecological damage caused by humans is roughly 1.6 times what nature can regenerate. Universally, the material consumption of natural resources on a national and per capita basis is increasing (Sandberg, 2021). If the collective consumption pattern mirrors the US, humans will require five-point one (5.1) earths, followed by Australia (4.5 earths) and Russia (3.4 earths). Further, Jafino et al. (2020) estimate that global warming and extreme weather will push between 30 and 130 million people into extreme poverty by 2030. Thus, highlighting the growth-consumption disparity among global citizens due to climatic events.

The over-consumption has ‘Got us here but won’t get us there’. ‘Get us there’ here refers to a sustainable future. There is a need for an evolved design thinking to enable a sustainable future for the present and future generations. Jauhiainen et al. (2023) propose ‘Metaverse’ as a part-solution to the above discussed environmental wicked problems. They assert that metaverse has potential to lead to substantial reductions in carbon emissions since consumers may substitute consumption of certain physical goods like apparel, footwear etc. with digital products. In the same vein, Townsend (2022) proposed that the increasing usage of metaverse can reduce physical mobility and construction. Thus, it can be said that virtual interactions among the users might lower the consumption behaviour and reduction in natural resource usage.

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2. Conceptualising Metaverse

The term metaverse combines 'meta' and 'verse.' It transcends the physical universe and takes the user on a virtual reality-based journey. The term ‘metaverse’ was first introduced in 1992 in Neal Stephenson’s Snow Crash. In its first iteration, the Metaverse was presented as a virtual reality (VR) dark planet approachable through the internet and augmented reality (AR) via virtual self or digital avatars.

The metaverse has been described as “a massively scaled and interoperable network of real-time rendered three-dimensional (3D) virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications and payments” (Ball, 2022, p. 29). The Metaverse can be envisaged as a series of interconnected virtual worlds, a network of 3D worlds, where users interact with content, objects, environments, and each other through virtual and augmented reality interfaces. In this parallel universe to the real world, people live their digital lives (Fig.1).

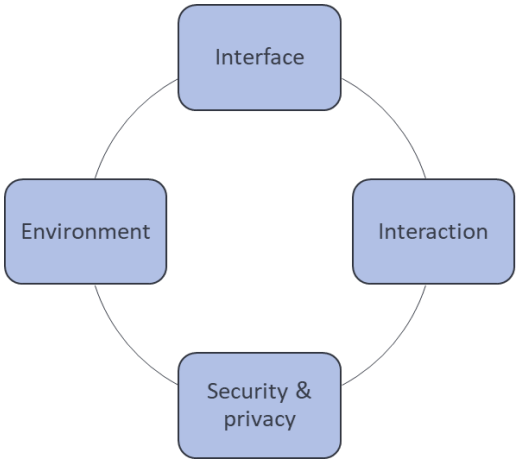

Fig.1 The conceptualization of Metaverse (Kim, 2021)

Globally, there has been increasing interest in the Metaverse due to an enhanced focus on developing community, socialising, new avenues of entertainment, showcasing creativity through various mediums, and the potential to amalgamate them into a financially viable business model. Accordingly, the study proposes to reflect on the emergence of the metaverse and its impact on a sustainable future for the new generations.

3. Sustainability and Metaverse

The concept of sustainability has evolved from the concern for the environment (Dobbers and Wolffe, 2000), to integration of economic development, social inclusion and effective and efficient resource management. In the integrational perspective there is a "simultaneous pursuit of economic prosperity, environmental quality, and social equity" (Elkington, 2002).

Metaverse is a virtual platform that enables its users (corporates and consumers) to interact mutually by using their digital avatars. Herein, simulations can be performed in cyberspace instead of material space, and larger awareness and more efficient interaction are created against harmful global phenomena, such as climate change. The emerging digital spaces may cause less environmental harm than their predecessors due to more advanced technology. Radically, a more dematerialized future is within reach, if people intend to buy fewer physical items, because more things can be purchased and consumed only digitally.

The sustainability advocates confidence is derived from the fact that organizations in every domain willingly participate in developing the metaverse ecosystem. Instances in the form of Accenture creating a digital headquarter to stimulate team(s) collaboration, South Korea is planning a Metaverse Seoul' – a full-service virtual world where the residents could perform touristic and administrative city-related activities, media and entertainment organizations like Disney, food chains like Wendy's, Donald's, entertainers like Daler Mehendi and even professional teams like the Atlanta Braves are exploring Metaverse to engage with their consumers and/or audience.

Tozzi (2022) asserts that the adoption of the metaverse will materially alter all the three dimensions- environment, social and financial –of sustainability in a positive manner. In similar vein Townsend (2022) believes that the metaverse may result in substantial reductions in carbon emissions since many physical goods will be substituted with digital ones, with virtual interactions simultaneously reducing the need for physical mobility.

4. Designing Metaverse for a sustainable future

"The metaverse is a collective, persistent, and interactive parallel reality created by synthesizing all virtual worlds to form a universe that individuals can seamlessly traverse. People can inhabit the metaverse using their digital avatars and experience the virtual world in multiple forms, including augmented reality, VR, and mixed reality" Gursoy et al. (2022).

Facebook transitioned to Meta on 28th Oct. 2021. The transition to metaverse represents a paradigm shift from the traditional online experiences to interactive, virtual and augmented reality environments in the new age of customer experience (CX) design. The metaverse has been envisaged to provide a good experience to its users (consumers), including competent and credible communication, and accessible visual guidance to assist in rapid awareness, comprehension and analysis. Thus, as Lee et al (2021) postulated, every element of the metaverse places human user at its core.

People can communicate with one another in this virtual environment using their avatars. Virtual reality (VR) and augmented reality (AR) are becoming ever more popular, and metaverses are swiftly advancing on the internet. The Metaverse led value creation opportunities are being explored by platform players, e.g., Meta, Sandbox; developers and creators that contribute resources, content, immersive layers, and the requisite hardware; companies and retail brands interacting with users in the virtual world, build destinations on virtual lands (e.g., Nova Scotia 360o), establish retail shops,

education (e.g., Hermitage Museum) and training purpose, or even create their customized built worlds (e.g., Yas Island, Abu Dhabi); and infrastructure and services enterprises (e.g., South Korea) that set design standards, facilitate transactions through digital currencies, and enable blockchain-based smart contracts.

The seamless experience Metaverse offers have enticed brands like LVMH, Gucci, Prada, Nike to explore the Metaverse for business opportunities. The fact that The Dematerialized, a virtual luxury showroom sold out its entire stock of 1212 digital sweaters (US$137 per piece) within three hours of its launch, highlights the evolving consumer behavior. The present-day consumer is equally conscious of his digital avatar personality and seeks to maintain equality between his physical and digital persona. Hence, it can be asserted that firms are increasingly considering Metaverse for their brand positioning and marketing-related activities. Accordingly, they are planning their budgeting with additional emphasis on metaverse-related activities.

The user adoption data on Metaverse looks promising. However, these are early development stages of Metaverse. The development of the Metaverse ecosystem requires designing an ecosystem for hyper-personalized, gamified learning and training, communal activities and UX-based interactions. Metaverse ecosystem can be described as a platform integrating 3D projection technology with Augmented Reality (AR) and VR into MR (Rauschnabel, 2022). Metaverse is designed to provide seamless experiences by transferring residents/visitors between the physical and digital environments. Virtual engagement provides several multisensory immersive experiences. Thereby enabling the organizations to transcend geographical limitations. Virtual Reality (VR) headsets allow users to experience virtual 3D environments from across the globe within the comfort of their homes or workplace. Through their self-created digital avatars, the users interact with other users in virtual surroundings. This virtual environment is conceptualized and designed on powerful technology platforms and enhanced computational capabilities available to today's developers

In present times, Customer experience (CX) is increasingly becoming technology-mediated. Organizations are deploying various technological tools for an enhanced CX (Anshu et al., 2022). The rapid ICT advancement has allowed developers to ideate and seamlessly introduce digital realities in the physical world of the users. Metaverse provides three-dimensional (3D) illusive experiences allowing for social interaction in blended living (Buhalis & Karatay, 2022), thereby, enabling a near-life-like experience by engaging multiple senses of the individual. An example can be seen in the hospitality industry, where Buhalis et al., (2022) states that hotels are using social media analytics in conjunction with AI to drive customer engagement and understanding of customer behavior across different market segments and in different decision-making stages. This allows hospitality organizations to customize their message and services to customers based on the customers' data (Tomczyk et al., 2022).

The authors posit that in the emerging metaverse ecosystem, in order to facilitate the encompassing experience and value creation in the digital ecosystem, necessary technologies-AR, VR, XR, and 3D-besides others must be developed, tested, and implemented, thereby enabling the multiple stakeholders to engage in the value co-creation process (Rubio et al., 2020). Hence, the design and re-design of technologies is an essential enabler for an immersive metaverse experience. The authors propose a framework moderated from Zhao et al (2022) (Fig.2)

The virtual environment of metaverse blends physical and digital, which consists of various scenes, non-player characters (NPCs) and player characters (Avatars). Scene refers to diversified virtual spaces, such as virtual campus (Duan et al., 2021) or virtual museum (Beer, 2015). NPC is an object that cannot be controlled by the player but has an important role in the game itself so that it makes the world in the game feel alive (Warpefelt and Verhagen, 2015). Avatar refers to the digital representation of players in the metaverse, where players interact with the other players or the computer agents through the avatar (Davis et al., 2009). The creation of these objects is based on

computer graphics techniques. The scene, NPC, and PC differ in the detail of their creation because they focus on different features.

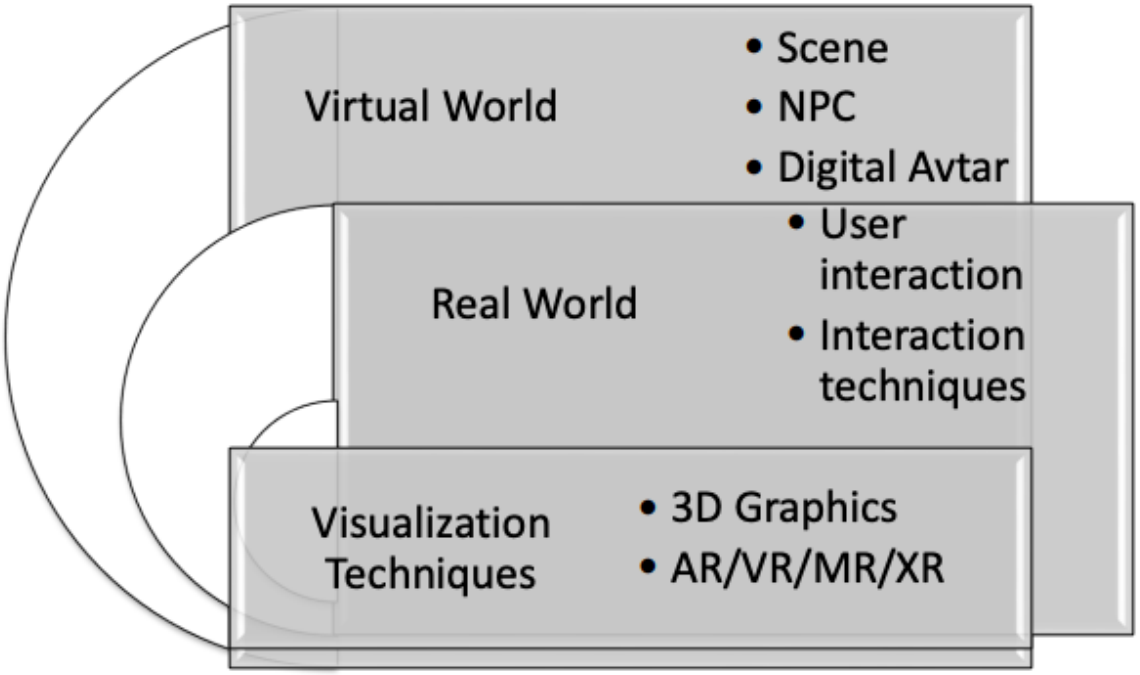

Fig.2 Metaverse Immersive Experience

5. User-Consumer-company interaction for Metaverse development

The previous research has unequivocally established that in order to transform users into consumers, companies need to connect with their consumers regularly. The latter is not just a recipient of one-way corporate communication but an active and vital participant in the entire communication cycle. The widespread adoption of social media has enabled consumers to transform from passive content receivers to active information seekers. The conventional consumer decision-making model has progressively made way for a technology-enabled-enhanced consumer decision-making model. Consumers are increasingly making purchase decisions based on online reviews, feedback, star ratings, and videos by past customers. They are influenced and, in turn, influence prospective consumers by sharing their opinions on different social media platforms. This e-WoM has a direct consequence for the businesses, either in a positive manner or detrimental to the businesses' interest. As Rihova et al. (2018) asserted, the spread of interactive technology across market segments has engaged consumers as active participants in business operations.

Metaverse has been identified as the next level of immersive-disruptive technology (Gursoy et al., 2022) after social media. The foundation of Metaverse- seamlessly integrating the physical and virtual worlds- can revolutionize the communication-interaction between organizations and consumers by enabling the co-creation of transformational experiences and values (Buhalis & Karatay, 2022) across industries.

6. Metaverse- led sustainability transition across industries

The success of Metaverse is predicated on the businesses' ability to be available 24X7 to their clients. The absence of time zones and ability to seamlessly shift between the real and virtual worlds is an

essential characteristic. If the participants could socialise in a uniform manner, irrespective of the medium, it will allow them to exchange value across digital platforms. The industries need to take cognizance of the changing consumer behaviour towards digitalization-led transactions. The organisations should encourage design and development of interoperable, customizable, and context-aware hyper connected virtual environments, wherein they can co-create customer satisfying experiences.

Specific consumer-based industries require constant consumer engagement. This is primarily true for the industries where service aspects outweigh the product utility. In the subsequent section, we analyse four such industries from the perspective of the Metaverse.

6.1 Metaverse in the retail industry

Jennifer (2019) estimates that by 2025 30% of global economic activity will be through digital platforms. A digital platform economy opens an opportunity for organisations to exchange value with their consumers without geographical boundaries. The essence of the evolving retail industry is the utilitarian exchange of value due to purchasing products and/or services from peer-to-peer and/or professional sellers.

In marketing, the metaverse ecosystem enhances the quality and nature of interactions with present and potential consumers. The consumers can virtually test drive the car, check the product characteristics before ordering, and experience its utility. Several retail brands have already incorporated metaverse in their marketing strategies. Nike recently launched virtual sneakers and apparel to be worn by digital avatars for the metaverse ecosystem (Sengupta, 2021). Through this offering, Nike earned US$3.1 Million in sales in seven minutes.

6.2 Metaverse in hospitality & tourism industry

In the post-pandemic 'new normal,' the hospitality industry can mitigate certain negative narratives by implementing immersive technologies like MR. This will allow them to achieve “a very realistic augmentation of the real world, ideally so realistic that a user can no longer distinguish virtual content from physical objects. MR usually requires special hardware (i.e., smart glasses) where the lenses are replaced by transparent screens and contain multiple sensors to track the user’s environment” (Rauschnabel, 2022). Hence, a technology-illusive implementation can lead to transformative experiences. The MR-based Metaverse experience is being experimented with by a few of the leading museums, like Louvre,

Furthermore, the hospitality industry faces the constant challenge of meeting and exceeding burgeoning client expectations. The client expects a seamless booking process, unique experiences, and personalized attention. Today’s travelers are majorly tech-savvy, and the implementation of metaverse by hospitality organizations could define the guest experience.

The accommodation search is the first step toward prospective clients' experience in the hospitality industry. Implementing a metaverse ecosystem can allow them to walk through the suggested room, enjoy the 360o perspective, and visualize the room amenities, décor, and other essentials. The potential clients in their digital avatars can have a first-hand immersive experience of hotel rooms, which conventional 2D images cannot provide. Thus, the hotel can transcend geographical boundaries and communicate directly with global travelers.

6.3 Metaverse in the entertainment industry

The effectiveness of Metaverse can be understood by taking an example of a cinematic experience. Over the last few decades, the advancement of technology and the popularity of 3D versions of movies like Avatar, Matrix, Avengers, etc., have encouraged cinema directors to increasingly incorporate 3D features in their films. Before the popularity of 3D movies and post that too, the viewers are passive participants only during the duration of the film. While the directors,

scriptwriters, and actors try their best to communicate and stimulate audiences' emotions, the same is not at the live-theatre levels. The performances at live theatre allow the audiences to enjoy a higher level of immersion since all their sensory faculties are in a closer relationship with the actors. Live shows in the Metaverse by performers like Ariana Grande, Justin Bieber, The Chainsmokers besides others allow the audiences to become part of the experience from their gadgets because, in the metaverse, experiences of digital and physical nature are inseparable and indistinguishable from the environment in which they occur. Thus, the entertainment industry and media can benefit from the realistic augmentation of the natural world, allowing the performer to transcend the limitations of venue capacity, distances, permissions, and statutory licences.

6.4 Metaverse in the gaming industry

Metaverse is emerging as “a parallel reality where humans can work, play, and communicate” (Gursoy et al., 2022). The game developers understand that the adoption of metaverse by gaming enthusiasts (with online games like Fortnite counting millions of active players on their platforms) will have a domino effect on other spheres of multiple industries too. Further, the growing Generation Z population provides demographic tailwinds to the adoption of Metaverse.

7. Issues and Challenges in Designing Metaverse for Sustainable Future

The digital ecosystem i.e. metaverse poses challenges for organisations, employees, business leaders, developers, UX designers, CX designers, content creators, marketers and even the consumers. The present employees lack the requisite technical skills to fully understand the contours of metaverse. The business leaders and their marketing teams too need to reorient their vision and strategies to accommodate this emerging phenomenon. This will require an extensive reskilling on both executive and higher management levels.

The societal implications of an unregulated metaverse cannot be overlooked. A regulatory framework wherein the stakeholders including the statutory authorities should together define an actionable road map leading to an ethical, safe, and inclusive metaverse experience. This will require regulations to be framed around data, security, laws of land, ethical behaviour, penalties in case of non-compliance, mental wellbeing, physical safety, equity and fairness among the participants.

Additionally, research has highlighted significant causes of concern relating to ethics, data security, regulation, and psychological impact on vulnerable community members. Already the Metaverse users are complaining about offensive and undesirable behaviours in the form of data exploitation, sexualization of avatar interactions, addiction to simulated reality, and privacy issues. In their recent report, Researchers for The Centre for Countering Digital Hate (CCDH) found that users were: "exposed to abusive behaviour every seven minutes".

Humans have developed everything across the world to make life of humans easier and do more than what's been happening previously -- it's the human centric growth approach that has been seen creating a parallel world where humans can feel, experience a virtual world, which is great but reality is what we need to really feel and stay in.

We have heard about split personalities. Haven't we? The new age split personalities are going to arise from the Metaverse, has one seen the psychological impacts of dual reality? We need to design ways to stop this happening.

Extensive exposure to the Metaverse / virtual world has led to a huge loss of Emotional Quotient in people, they are slowly losing their individuality as the singularity of the human race is becoming a stark reality in our face. Imagine a world that is void of cultures, social differences, design variations!!! No, we need to go well beyond this while we design the Metaverse of the future. It must act as a tool to enhance the sensitivities rather than dulling the same. The designing of the future has

to come in the Metaverse keeping the sensibilities of the need, ease, environment, emotions, hallucinations of the human mind, only then can we go beyond.

8. Conclusion

The initial advantages of the metaverse are already accruing to the first-mover companies. As visible in earlier technological advancement stages, the early adopters gain a comprehensive competitive advantage which the other firms seek to mimic. The metaverse has the potential to impact all the domains of management- from HR to marketing, operations, and supply chain logistics. Presently, business leaders should examine its potential applications, its effectiveness in domains, its boundaries, if any, and how the metaverse could be a precursor to the new world predicated on digitalization.

In its limited scope, the present study examined the evolving concept of the metaverse and its purported influence on creating a sustainable future. But for that it is imperative that it gains universal acceptance. The authors posit that for the metaverse to gain acceptance, it is necessary that the stakeholders have a clear strategy for integrating it with human behaviour. They should strategize and design the application of metaverse for consumption related decision-making. As evidenced earlier in the study, businesses are making efforts to make their operations sustainable by exploring the opportunities offered by the metaverse.

Hence, we can conclude that the metaverse interconnects the virtual and real world and has the potential to bring about a sustainable future. It offers immense opportunities in social, economic, and cultural spheres for organizations to identify, recognize and adopt sustainable practices.

References

Anshu, K., Gaur, L., & Singh, G. (2022). Impact of customer experience on attitude and repurchase intention in online grocery retailing: A moderation mechanism of value Co-creation. Journal of Retailing and Consumer Services, 64, 102798.

Ball, M. (2022). The metaverse: and how it will revolutionize everything. Liveright Publishing.

Bastien-Olvera, B. A., & Moore, F. C. (2021). Use and non-use value of nature and the social cost of carbon. Nature Sustainability, 4(2), 101-108.

Beer, S. (2015, April). Virtual museums: an innovative kind of museum survey. In Proceedings of the 2015 Virtual Reality International Conference (pp. 1-6).

Buhalis, D. (2019). Technology in tourism-from information communication technologies to eTourism and smart tourism towards ambient intelligence tourism: a perspective article. Tourism Review.

Buhalis, D., Lin, M. S., & Leung, D. (2022). Metaverse as a driver for customer experience and value co-creation: implications for hospitality and tourism management and marketing. International Journal of Contemporary Hospitality Management, (ahead-of-print).

Buhalis, D., & Foerste, M. (2015). DoCoMo marketing for travel and tourism: empowering co-creation of value. Journal of destination marketing & management, 4(3), 151-161.

Buhalis, D., & Karatay, N. (2022). Mixed reality (MR) for Generation Z in cultural heritage tourism towards metaverse. In ENTER22 e-Tourism Conference (pp. 16-27). Springer, Cham.

Davis, A., Murphy, J., Owens, D., Khazanchi, D., & Zigurs, I. (2009). Avatars, people, and virtual worlds: Foundations for research in metaverses. Journal of the Association for Information Systems, 10(2), 1.

Duan, H., Li, J., Fan, S., Lin, Z., Wu, X., & Cai, W. (2021, October). Metaverse for social good: A university campus prototype. In Proceedings of the 29th ACM international conference on multimedia (pp. 153-161).

Elkington, J. (2002). Corporate strategy in the chrysalis economy. Corporate Environmental

Strategy, 9(1), 5-12.

portal (2022). Retrieved 19 October 2022, from https://europeangaming.eu/portal/ latest-news/2021/11/02/103027/search-data-reveals-absolutely-no-one-understan ds-the-metaverse/

Frederikse, T., Landerer, F., Caron, L., Adhikari, S., Parkes, D., Humphrey, V. W., ... & Wu, Y. H. (2020). The causes of sea-level rise since 1900. Nature, 584(7821), 393-397.

Fuller, R., Landrigan, P. J., Balakrishnan, K., Bathan, G., Bose-O'Reilly, S., Brauer, M., ... & Yan, C. (2022). Pollution and health: a progress update. The Lancet Planetary Health.

Gursoy, D., Malodia, S., & Dhir, A. (2022). The metaverse in the hospitality and tourism industry: An overview of current trends and future research directions. Journal of Hospitality Marketing & Management, 1-8.

Jafino, B. A., & Kwakkel, J. H. (2020). Exploring the changing efficiency and equity of the agricultural sector in the Vietnam Mekong Delta due to evolving human-environment regimes. In AGU Fall Meeting Abstracts (Vol. 2020, pp. GC072-0007).

Jennifer S. (2019), "The Platform Economy," The Innovator, Retrieved from (https://innovator.news/theplatform-economy-3c09439b56). Accessed on 11 March 2023

Jauhiainen, J. S., Krohn, C., & Junnila, J. (2023). Metaverse and Sustainability: Systematic Review of Scientific Publications until 2022 and Beyond. Sustainability, 15(1), 346.

Kim, J. (2021). Advertising in the Metaverse: Research agenda. Journal of Interactive Advertising, 21(3), 141-144.

Kumar, A., Prakash, G., & Kumar, G. (2021). Does environmentally responsible purchase intention matter for consumers? A predictive sustainable model developed through an empirical study. Journal of Retailing and Consumer Services, 58, 102270.

Lee, B., Hu, X., Cordeil, M., Prouzeau, A., Jenny, B., & Dwyer, T. (2021). Shared surfaces and spaces: Collaborative data visualisation in a co-located immersive environment. IEEE Transactions on Visualization and Computer Graphics, 27(2), 1171-1181.

Oberle, B., Bringezu, S., Hatfield-Dodds, S., Hellweg, S., Schandl, H., & Clement, J. (2019). Global resources outlook: 2019. International Resource Panel, United Nations Envio, Paris, France.

Park, S.-M., & Kim, Y.-G. (2022). A Metaverse: taxonomy, components, applications, and open challenges. IEEE Access, 10, 4209–4251

Rauschnabel, P. A. (2022). XR in tourism marketing. In Encyclopedia of Tourism Management and Marketing (pp. 816-819). Edward Elgar Publishing.

Rihova, I., Buhalis, D., Gouthro, M. B., & Moital, M. (2018). Customer-to-customer co-creation practices in tourism: lessons from customer-dominant logic. Tourism Management, 67, 362-375.

Rubio, N., Villaseñor, N., & Yagüe, M. (2020). Value co-creation in third-party managed virtual communities and brand equity. Frontiers in Psychology, 11, 927.

Sandberg, M. (2021). Sufficiency transitions: A review of consumption changes for environmental sustainability. Journal of Cleaner Production, 293, 126097.

Sengupta D. (2021). Nike Acquired This Company That Makes Virtual Sneakers and NFTs for the Metaverse. Retrieved from https://beebom.com/nike-acquired-company-makes-virtual-sneakers- nfts-metaverse/. Accessed 12 October, 2022

Song, F., Zhang, G. J., Ramanathan, V., & Leung, L. R. (2022). Trends in surface equivalent potential temperature: A more comprehensive metric for global warming and weather extremes. Proceedings of the National Academy of Sciences, 119(6), e2117832119.

Stephenson, N. (1992). Snow Crash. New York: Bantam Book

Tomczyk, A. T., Buhalis, D., Fan, D. X., & Williams, N. L. (2022). Price-personalization: Customer typology based on hospitality business. Journal of Business Research, 147,

462-476.

Townsend, S. (2022) Could the metaverse & web3 save sustainability? Forbes Available online: https://www.forbes.com/sites/solitairetownsend/2022/09/29/could-the-metaverse--web3-save- sustainability/?sh=bdbf76364633/

Tozzi, C. (2022) Will the Metaverse Help or Hinder Sustainability? ITPro Today. Available online: https://www.itprotoday. com/sustainability/will-metaverse-help-or-hinder-sustainability

Warpefelt, H., & Verhagen, H. (2015). Towards an updated typology of non-player character roles. In Proceedings of the International Conference on Game and Entertainment Technologies (pp. 1-9).

Zhao, Y., Jiang, J., Chen, Y., Liu, R., Yang, Y., Xue, X., & Chen, S. (2022). Metaverse: Perspectives from graphics, interactions and visualization. Visual Informatics.