

Review

Metaverse in tourism service: Exploring digital tourism innovation

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Abstract: This study explores the integration and challenges of metaverse technology in tourism, analyzing perspectives from the industry, travelers, and management. It underscores the digital transformation accelerated by the COVID-19 pandemic, technological advances, and Generation Z influences. The research identifies key applications of metaverse technology, such as digital eco-tours, museums, cultural performances, and souvenirs, which redefine the traditional tourism model. It also examines the unique experiences provided to tourists by the metaverse at various stages of travel—before, during, and after trips—and evaluates the implications for customer perception and behavior. From a management viewpoint, the study highlights the necessity for thorough assessments of metaverse implementations in customer relations, marketing, and organizational strategies to fully gauge its impact. The discussion section addresses the long-term effects on traditional tourism practices and destinations and articulates how these technologies transform customer engagement and operational paradigms. This research provides a comprehensive overview of how metaverse technology reshapes the tourism landscape, offering insights for future technological integration and strategic development.

Keywords: Metaverse-based tourism; virtual tourism; digital tourism; COVID-19 pandemic; Generation Z; immersive and interactive tourism; VR/AR/MR technology

1. Introduction

The world's tourism industry is facing an unprecedented digital transformation, accelerated in particular by the COVID-19 pandemic, innovations in technology, and the influence of Generation Z.

1.1. Pandemic

The pandemic's effects have altered the world in various aspects, including society, economy, technology, and the way people around the world live. A more significant impact is the increasing number of people choosing to work remotely or in a hybrid mode [1]. The digital uptake in different industries has accelerated since the COVID-19 pandemic, as evidenced by the emergence of new products or services such as Virtual Wine Tasting Journey [2,3] and Virtual Museums [4]. Tourism is a major economic industry in the world and has become an important mechanism to boost global business. The industry is directly impacted by pandemics and therefore has caused a lot of damage due to viral disruption [5]. In the tourism sector, adjustments have been made to support tourism in the post-pandemic era through the application of modern information technology to improve the efficiency of tourism management [6].

People's demand for travel is also essentially a desire to see, touch, and feel an exotic experience that is completely different from their living space. However, with the outbreak and continuation of COVID-19, it has become very difficult for people

to experience exotic places conveniently. Travel trends in the post-COVID-19 era suggest that travelers are focusing more on “virtual tourism” before traveling to their destinations [7]. In contrast, COVID-19 Travel Anxiety (CTA), which refers to a failure to participate actively in travel activities and the persistent concern of coping with COVID-19-related travel limitations, has led to the increased appeal to virtual environments (for example, metaverse-based travel) since the outbreak [8]. Travelers’ cost-consciousness and technology awareness are resurrected in the “new normal” and they expect interactive, immersive, and valuable travel experiences. When travelers are unable to travel in real-time due to the COVID-19 protocol, communities begin to find alternative ways to continue their activities to satisfy their desires [9]. Therefore, in the pandemic context, digital tourism is one of the most popular and recognized patterns of contemporary tourism for the travel industry or travelers.

1.2. Technological innovation

Digital technology is critically needed to enhance service quality and travel safety for the conventional tourist business, which confronts significant difficulties. The development of ICT has also contributed to the technological revolution in the tourism industry. The tourism industry has also adjusted by incorporating information technology into its operations, which could result in the concept of smart tourism [10]. It provides travel companies with strategic resources to improve the traveler experience through technology engagement and product smartness [11]. Customer experience in the tourism industry is more related to technology mediation. The tourism sector makes use of advanced ICT to comprehend consumer behavior across a variety of market sectors at various decision phases. Information technology also enables the travel industry to provide personalized services to clients depending on the contextual data gathered from them through various digital means [12].

Virtual reality allows resources for tourism to be temporal, spatial, storytelling, and interactive [13]. Virtual reality uses IT-based technology to create a simulated environment that closely resembles the real one [14]. The metaverse is one of the simplified technologies for virtual tours. Virtual experiences related to the metaverse can provide insight into the evolution of technology and its significant influence on tourism. The travel industry is keen to identify how metaverse can be used to generate virtual travel experiences, products, and services that provide value to consumers [7].

Metaverse technology has changed the perception of virtual technology and its influence on tourism [15,16]. With the gradual development of metaverse technology, more tourism businesses expect to use the technology to create virtual tourism experiences and services for tourists. It can be argued that the emergence of this technology could revolutionize the way tourism is developed, as virtual tourism changes the way tourists choose their destinations. Although the technology is currently unable to completely disrupt the perception of traditional technology, the development of advanced technologies such as full-body wearable systems, virtual 3D glasses, and other quality improvements will eventually allow for the development of an immersive tourism metaverse [17]. Therefore, technological innovation is an important part of tourism development, which brings interactive and immersive experiences to tourism.

1.3. Generation Z

The tourism industry is gradually being replaced by the “experience economy” and traditional travel methods can not satisfy the demand of consumers, especially with the emergence of a new cultural consumer group, Generation Z, which aspires to an immersive experience of travel with modern technology. Generation Z is known as the digital natives because of the rapid development of the Internet, which has given this generation full access to the convenience of technology first [15]. Compared to previous generations, Generation Z is well-educated and more receptive to high-technology products. Generation Z travelers are increasingly interested in transformative experiences and have begun to engage in tourism activities through more travel. Instead of traditional tourist attractions, Generation Z prefers innovative and funny experiences [18]. Generation Z has influenced the travel industry with the need for more engaging experiences from all sectors.

Tourism is an information-intensive industry [19]. To accommodate the needs of the Generation Z population, tourism destinations need to be heavily modernized to create transformative experiences. A metaverse-based tourism will undoubtedly support Generation Z in co-creating transformative experiences. Virtual Reality (VR) brings them more engagement and variety in experience [20]. Enhancing technology through immersive experiences increases the value of the entire user engagement, particularly when integrated with customization tailored to the preferences of each Gen Z customer [21].

1.4. Innovative tech synergies in tourism

Real-time Data and Tourism Dynamics. The integration of real-time data processing and dynamic social network analysis in COVID-19 vaccination strategies offers valuable insights for the tourism industry. Similar technological applications within metaverse platforms can facilitate the tracking of tourist behaviors and preferences in real-time. This approach can enhance personalized service delivery and adaptive management strategies, providing a dynamic and responsive system that parallels public health strategies. Such innovations could transform how tourism businesses engage with and respond to tourist needs in a continually evolving digital landscape [22].

Advancing Metaverse Interactions with M-FLAG. The M-FLAG framework introduces advanced techniques in medical vision-language pre-training, employing optimized language and visual models that could be pivotal in enhancing user interactions within the metaverse. By adopting similar methodologies, the tourism sector can improve the presentation and interaction within virtual tourism environments. These technologies have the potential to increase user engagement and satisfaction by delivering contextually relevant content, thereby setting new standards for immersive tourist experiences [23].

Inclusive Communication with Med-UniC. Cross-lingual and unbiased communication strategies utilized in the Med-UniC framework highlight the importance of inclusivity and accessibility in digital applications. By applying these strategies to the tourism sector, it is possible to create a metaverse that is accessible and appealing to a global audience. This approach not only broadens the appeal of

digital tourism initiatives but also enhances their ethical reach, ensuring that the digital tourism experience is equitable and can be enjoyed by a diverse clientele across different linguistic and cultural backgrounds [24].

These insights from various fields underscore the transformative potential of emerging technologies. By learning from these innovative applications, the tourism industry can develop more engaging, responsive, and inclusive tourist experiences that are well-suited to the demands of the modern digital era.

The influence of the above-mentioned representative factors has also prompted more researchers and practitioners to focus on the application of advanced technologies (e.g., metaverse) in the tourism industry. The purpose of this study is to explore the changes and opportunities brought by metaverse technologies to the tourism industry from the perspectives of the tourism industry, travelers, and tourism management.

2. Metaverse

2.1. Background of Metaverse

Metaverse means “beyond the universe”, meta means beyond, and verse means universe. In its deeper meaning, it refers to a virtual space parallel to and separate from the real one. It is a 3D-based virtual world that transitions to another world, breaking the boundary between real and virtual spaces [25]. Metaverse provides immersive experiences with intense social interaction, effectively causing a hybrid life [1]. People can reside in the metaverse with avatars and enjoy the virtual world in many ways.

Virtual reality (VR), augmented reality (AR), mixed reality (MR), artificial intelligence, blockchain, 5G, wearable technologies, and sensor technologies provide opportunities for a metaverse world [26]. VR users are provided with a fully immersive digital space where they cannot view the real world, and AR users add digital capabilities to the experience of the real world. Users can experience enhanced destination features through their AR devices. MR may transform digital data over real objects and environments [27]. Thus, it is possible to bring physical objects into the simulated universe and virtual objects into reality [28].

Metaverse first entered our lives in 1992 together with Snow Crash and was marketed in 2003 as Second Life, a social virtual universe game [29]. However, the idea of the metaverse even goes back to E. M. Forster’s 1909 book *Machine Stop*. Over a century after the publication of *Machine Stop*, the metaverse has regained attention recently as Facebook renamed itself “Meta” [30]. During the COVID-19 pandemic, its popularity grew as physical movement and human touch became limited, and it has lately been adopted in tourism [31].

2.2. Metaverse combined with tourism

Metaverse-based tourism employs a blend of MR and physical reality to bring together tourism-related requirements and stakeholders in a shared virtual environment and augment the physical space into an MR space, converting the Internet into a parallel virtual world [15].

Metaverse technology is gaining attention in the tour industry. Increased

awareness of carbon reduction, changing customer requirements and desires, and other external influencers may motivate individuals to visit destinations that practice sustainable tourism. Changes in visitor perceptions may even motivate them to experience one of the offerings in the metaverse without compromising any expected profits of reducing their carbon footprint [17]. These possible changes in clients' behavior underscore the importance of industry efforts to develop and deliver real travel experiences in the metaverse. Because much of the use of the metaverse remains aspirational, a growing number of hotels and tourism organizations are developing their presence on the metaverse platform to create mechanisms for interaction and transactions. As virtual hospitality and tours transform the way people choose their accommodations and destinations, these metaverse-based applications are revolutionizing the travel industry [15,32]. Although metaverse cannot substitute for in-person trips, technological advances and improved quality are making metaverse travel apps increasingly immersive. As a result, metaverse-based travel experiences may even be the next disruptive element of the industry. Travel industry participants need to recognize this new phenomenon and develop plans to actively integrate into this new environment and take advantage of this chance to build a development advantage.

3. Industry perspective: Metaverse application breakthroughs in tourism

The study considers that the breakthrough of metaverse technology in the tourism industry is manifested in digital eco-tours, digital museums, digital cultural performances, and digital souvenirs, which fundamentally change the business scope of the traditional tourism industry and will bring potential opportunities to the development of tourism industry [33].

3.1. Digital ecotourism

People enjoy participating in various types of outdoor ecotourism activities, such as hiking, biking, wildlife viewing, and other large-scale activities, mainly from national forests or protected areas with beautiful environments. As the economy has entered the digital age, digital technology and ecotourism may well be integrated. Digital technology can provide tourists with personalized travel service support [34]. With the pandemic, travelers can experience the world's different scenic spots safely and efficiently through digital tourism.

The metaverse technology that attracts tourism organizations has recently been improving [5]. For example, 3D, MR, and holographic imaging offer a whole range of non-contact tourism technologies. The collection and design of ecological landscapes are accomplished through satellite remote sensing as well as GIS technologies. Digital twins of ecological landscapes are then created at metaverse nodes using digital landscape technologies. The constructed digital twins are extended to different landscape spaces through metaverse technology. Different digital landscape locations will eventually form an interconnected 3D digital ecotourism space.

Thus, shaping 3D digital landscape spaces through metaverse technology can be used as a complement to non-contact tourism during the pandemic. The technology

also provides an immersive experience and fun for visitors, and the digital natives of Generation Z do not even have to leave their homes. Simply by wearing 3D glasses, they can view the natural landscape from all angles and even interact with others in the landscape to share the experience of the tour.

3.2. Digital museums

The pandemic has severely hurt the tourism business, and museums among them have suffered detrimental effects. To better serve visitors, museums have also experimented with Internet technologies for online tours [35]. Some museums have introduced online VR galleries that simulate people visiting in real life, allowing visitors to tour online without having to travel to their destination on the ground. Museums can also digitally preserve museum artifacts through new technologies such as digital image capture and artificial intelligence.

While digital technologies are drawing attention and using Internet platforms to give visitors an immersive digital experience, the tourism industry needs to be aware of the fact that the digitization of museums can lead to new opportunities for digital development in tourism. Metaverse technology can provide a digital twin for museums. A dynamic digital twin of museum collections is constructed through 3D scanning and video dynamic imaging. Unlike the static images currently seen on the web, the dynamic digital twin technology can present visitors with online 3D images 24/7. Visitors can use different devices, such as 3D glasses and holographic projection tools, to visit dynamic museum exhibits in a full 360 view.

At the same time, digital twin artifacts can be constructed to emulate museum collections [26]. Real artifacts are generally very difficult for individuals to own, but visitors can own online digital artifacts. Digital artifacts facilitate awareness of the historical and cultural context of the collection and improve the tourist's perception of the collection.

Digital artifacts have the potential to be traded and can be sold and auctioned in the metaverse space. Blockchain technologies in the metaverse, such as NFI (non-homogenized tokens), can construct unique attributes for digital artifacts. Digital artifacts have unique digital codes in the metaverse and are cryptographically preserved using blockchain technology. The digital artifacts supported by blockchain have characteristics such as historical age, appearance characteristics, and special material properties. Museums can value and provide authenticity endorsement for digital artifacts.

3.3. Digital cultural performing arts

Some attempts have emerged about digital cultural performing arts based on metaverses, such as metaverse music festivals and metaverse fashion weeks [36]. This form can be an effective supplement to digital tourism. The integration of metaverse and cultural performing arts is mainly manifested in the use of metaverse technology to provide virtual character participation, immersive performance, cross-history and spatial presentation, and other forms.

Virtual character participation means that visitors participate in the stage performance in the form of avatar characters, and actors cooperate, integrating and

even playing multiple roles. This kind of avatar participation meets the role-playing expectations of some audiences, and additionally enriches the digital tourism products; virtual performance mainly through 3D and holographic projection technology, presenting the scenes, sounds, and three-dimensional images of the performance to the visitors. Visitors will immerse themselves to enjoy the fun brought by this performance; cross-history and space performances can be free from the constraints of the stage and present the situation of history or future space in the metaverse.

The interactive immersive experience brought by the multi-faceted fusion of metaverse technology and cultural performance tourism will attract the interest of more tourists [5]. This fusion may be the future trend of digital cultural performing arts tourism.

3.4. Digital souvenir

The blockchain in the metaverse is essentially a shared database. The stored data has characteristics such as unfalsifiable, open, and traceable [37]. These features provide the trust foundation of blockchain technology and establish a dependable cooperation system with potential application prospects. The value of NFT based on blockchain technology lies in its uniqueness and low-cost identifiability. This technology can be used to create digital souvenirs for tourist attractions.

NFT technology can realize the digital mapping of real matter in the metaverse, while peer-to-peer transaction technology is to realize the establishment and transfer of the relationship between human and digital object ownership [38]. Digital souvenirs related to scenic spots can become the value storage and trading medium of the metaverse.

Tourism suppliers can develop digital souvenir products through NFT technology and release digital souvenirs based on the unique resources of scenic spots. Digital souvenirs with special properties can be released to the metaverse platform for trading. Tourists acquire ownership by purchasing, and the souvenir is combined with the unique digital identity of tourists to form a unique hybrid digital product. The NFT technology gives the tourism digital souvenir special attributes that make this type of hybrid digital souvenir valuable for investment and appreciation. Visitors who already hold such hybrid digital souvenirs can collect, trade, and auction them online.

4. Tourist perspective: A three-stage tour oriented to metaverse technology

Different technologies bring different feelings to the tourist, so this study explores the tourist experience at different stages of the tour (before, during, and after) to analyze the advantages that metaverse technology offers to tourists that are different from traditional tours.

Metaverse is used to tailor and co-create a hybrid virtual world that allows travelers to immersive interact with themselves and other customers before, during, and after their visit. Dwivedi et al. [39] propose that technology transforms the real experience of the tourist before, during, and after the trip. The integration of real experiences with virtual worlds has transformative implications for traditional tourism and presents significant opportunities for all stakeholders in the tourism industry.

Tourism suppliers can connect virtually and physically with various stakeholders and clients. Through metaverse technology, tourism suppliers can leverage multi-sensory content to deliver an array of immersive experiences and expand their business.

4.1. Before travel

When travelers perceive insecurities, such as health threats like COVID-19, they look for more reliable options. Some travelers also experience financial constraints and will look for inexpensive alternatives. The metaverse is becoming increasingly popular as a platform for interacting in a virtual environment, providing an immersive, safe, and inexpensive alternative to real-time travel. As with other activities, some travelers are beginning to shift their daily lives to digital or virtual solutions [40].

Before traveling, clients can choose and customize their personalized trip by virtually checking the destination and planning their trip in the metaverse system. Travelers can invite others (family or companions) to co-design their experience, especially those with whom they plan to travel [41]; metaverse can meet the needs of customers who want to try actual travel services before they buy or book them. Tourists experience virtual travel services before actually visiting the destination and get a feel of the tour through the virtual environment. Travel information gathering and fact-finding are conducted before the visit. These efforts will provide clients with a “try before you buy” option that will allow them to explore the travel services they are interested in; metaverse-based experiential tourism can also provide special incentives to customers who book travel services [17]. People may interact with the metaverse scene and have an immersive experience before the tour. Interactive experiences can recreate real-world environments. By removing service ambiguity and establishing explicit service expectations, metaverses can improve bookings and consumer readiness to pay higher fees.

The metaverse provides important interactive service opportunities for tourism suppliers and their clients. Tourism suppliers adopt the metaverse to build client relationships and marketing before visitors plan their trips. Tourism suppliers can interact with customers in both virtual and real worlds with the help of the metaverse [42]. In the interaction, tourism suppliers allow visitors to co-create interactive experiences through metaverse technology. In a more immersive way, tourism providers promote their business to travelers while facilitating value co-creation. Metaverse technology allows travelers to try out tourism products and services before actually visiting the destination, thus creating more touchpoints with tourism suppliers. Tourism suppliers may also use the metaverse system to prepare for potentially disturbing real travel experiences, saving customers time and money as they plan their trips.

4.2. In travel

Some emergencies, such as COVID-19 travel anxiety (CTA), exacerbate the shift in tourist preferences for metaverse travel. In this state of mind, tourists expect to in some way satisfy their desire for everyday travel tasks, which metaverse technologies can support [8]. Metaverse-based free tours offer an experience almost similar to real-time tours. With the help of metaverse technology, people staying at home can have a

real travel experience. Even before traveling to a real travel destination, metaverse can provide visitors with an immersive virtual travel experience and assist them in making wise choices and jointly creating travel value. Thus, metaverse can leverage the virtual environment to increase consumer satisfaction. Metaverse-supported travel is manifested in virtual tours, low-carbon tours, personalized tours, digital shopping, and real-time sharing of travel experiences [15].

Virtual tours. In the digital world built by metaverse technology, virtual tours can be realized via reading text, hearing audio, and viewing images of the world. Visitors can view the scenery, visit museums, and participate in cultural and literary arts in the digital world. Personal digital visual and auditory stimuli can be reproduced relatively easily throughout the metaverse, and to some degree, simulate personal interaction.

Low carbon tours. The metaverse has been used in tourism to create customer experiences. This can benefit by reducing the carbon footprint of tourists while saving time, money, and other resources [17].

Personalized tours. A metaverse-based system for the tourism platform allows users to receive information about featured tours through a matching system. The tours are selected by setting the desired search criteria [30]. By projecting their avatar through users' mobile and smart devices, travelers can experience different tour contents without spatial and temporal constraints [43]. They will be able to travel to different featured attractions through their avatars, voices, facial expressions, and wearing the chosen clothes.

Digital shopping while traveling. People can trade with avatars in the metaverse system. Digital artifacts, collections, and souvenirs are displayed and sold through the support called NFT (Non-Fungible Tokens) [44].

Real-time sharing of travel experiences. The metaverse makes it easy and interchangeable to create experiences in both virtual and real environments. During the tour, clients can communicate and influence one another in real-time by exchanging information with other clients.

4.3. Post-travel

After participating in a tour supported by the metaverse platform, visitors will rate the destination in action on social media platforms, connect with travel service providers and other travelers, and plan further trips in the future.

Post-tour evaluation. After a tour, consumers can review how they felt about the tour and provide suggestions for other travelers or their next trip. Driven by technology, travelers can view online reviews shared by past visitors and make better choices of destinations to purchase. The emergence of social communication media has also transformed travelers into proactive information receivers. With the help of social media platforms, tourists can provide their travel experiences and therefore will advise other consumers [45]. It is widely acknowledged that the metaverse will be the next revolutionary technology, following the broad use of social media platforms. As smart devices become more prevalent, more travelers can share their travel experiences in real-time and broadcast their experiences live.

Interactive relationships. The use of metaverse allows for a different process of sharing, feedback, and evaluation of the travel experience after the trip, and therefore,

tour suppliers and tourists may establish a more immersive interaction than traditional tours using a mix of communication methods. This interaction between both parties becomes crucial for the tourism experience [46]. Metaverse immersive elements enable easier interaction between visitors. In metaverses, tourists can exchange sensory data with one another through the metaverse system, in addition to creating communities and sharing contexts of common interest.

Revisiting destinations. Behavioral models of travel indicate the relationship between travel quality, satisfaction, and revisiting to investigate whether tourists can revisit the destination [47,48]. The metaverse allows travelers to merge the physical and virtual realms. It successfully builds an interactive link that enables the seamless fusion of physical and digital experiences. High tour quality and satisfaction can be expected in the metaverse environment. Metaverse offers more business opportunities for tour providers. Tour providers can collaborate and build strategic alliances with others that have gained a better track record in the metaverse platform to offer different destination experiences. Tourists can choose to revisit and visit other destinations at the same time.

5. Management perspective: Tourism management related to the metaverse

Tourism providers should explore opportunities for business model innovation and ensure that organizations capture sustainable business development [49]. The development of metaverse-based tourism is in its early stages and tourism management should leverage the opportunities presented by the metaverse to enhance their digital competencies and gain a competitive advantage. Different types of tourism businesses should develop different business strategies based on their strategic needs and plan accordingly for the long term. Metaverse technology drives the digital transformation of the tourism ecosystem, requiring all functions and business processes to be reengineered to accommodate technological innovation. Metaverse should be examined comprehensively as innovations are implemented, including customer relations, marketing, technology, human resources, governance, etc. to analyze the full impact of metaverses on the tourism business.

5.1. Client relationships and value co-creation

The metaverse is a virtual environment that allows users to use their avatars to interact socially, create value, and co-design experiences [17]. The metaverse links the digital and physical worlds through ambient intelligence combined with technology that allows users to merge resources and gain access to complete experiences [50]. Co-design can be raised to a new layer as staged experiences can generate more advantages. The eventual control of the virtual space supports the development of user personalization.

The metaverse will disrupt the travel experience as well as the co-creation process of the service experience. Metaverse technologies can support tourists in preemptive experience and uncertainty avoidance, thus helping to facilitate the purchase behavior of travel services. By shifting control of clients' experience co-creation from the service provider to the consumer, the service co-creation process can be democratized.

By doing so, the value created for tourism stakeholders through the metaverse can be measured. In the specific context of tourism, the metaverse can be explored in the future to identify the consumer values and motivations of customers for tourism purposes.

5.2. Recruitment and skills training

When exploring metaverse-based tourism, tourism providers need to assess human resource management (HRM) and reconsider their current HRM situation [51]. The metaverse may create new employment opportunities, but the concern remains how to staff for these opportunities. There may be job changes and new positions in the tourism organization after business process re-engineering. HRM should consider how to staff from the tourism or technology areas. Employees in the metaverse who serve customers traveling in a virtual environment will need to have new skills. These competencies can include technological capabilities related to digital knowledge, but also knowledge of consumer psychology in a virtual environment. HRM should focus on identifying new skill gaps among staff and looking at ways to bridge these gaps.

5.3. Marketing

Marketers must proactively understand and adopt new technologies for consumer engagement and service, such as using digital technologies to capture the deep interrelationships between consumers and travel suppliers anytime, anywhere, driving further personalization and contextualization. Unlike digital marketing where customers access travel-related digital platforms, marketers in metaverse systems need to access the user's metaverse and use artificial intelligence technologies to analyze customer behavior. Therefore, marketers must design innovative interactions to dynamically interact with customers in the metaverse.

It is also necessary for marketers to establish marketing campaigns and service recommendations to appeal to virtual users. Marketers need to find segmentation tactics that benefit both them and their target audience. There is an urgent need to analyze metaverse-related marketing tactics. The metaverse is an interactive virtual environment. It is suggested that the creation of interactive advertising models can be considered. Using the interaction advertising model, the properties of messages and avatars can be determined by researchers.

5.4. Metaverse technology development

With the popularity of the metaverse concept, more tourism organizations are using VR technology to exploit tourism resources. Virtual design technology can realize human-computer interaction in tourism scenes and promote tourism development so that people can travel in the virtual environment [52]. The realization of the metaverse also relies on the integrated use of digitalization, artificial intelligence, VR, the Internet of Things, and blockchain technologies, and also includes the construction of infrastructure technologies such as 5G and GPU. The application of metaverse in tourism scenery needs to emphasize the research and development of related technology fields. The metaverse's current systems and technologies are still developing and lack several features, including difficulty in

customization or authorization, and the inability to easily and interchangeably run characters, scenarios, or digital assets [53]. It is expected that a platform that is easily customizable, scalable, and works with other metaverse systems will be developed in the future.

Traditional tourism companies need to collaborate with technology companies to provide metaverse service technologies to meet the growing interest of tourists and travelers in metaverse or VR tourism. Businesses that already operate in the virtual reality and metaverse can incorporate digital and virtual tourism activities to appeal to a large consumer pool. Travel providers and technology companies may plan their metaverse-based tourism business models according to their technological proficiency.

5.5. Digital governance

While metaverse technology can aid in the growth of the tourism industry, digital technology itself brings issues such as digital addiction, security, and environmental protection that require a high level of attention from tourism practitioners.

Digital addiction. People spend more time in the virtual environment than in the physical environment. Positive experiences in virtual environments should be designed to ensure that these experiences are not overused, leading to obsession [54]. Transactions in virtual spaces can also lead to unusual and reversible patterns of behavior, such as potentially compulsive behaviors of consumers who engage in virtual financial transactions that may cause overspending [55]. Overspending can also produce indirect impairment of social skills, which can lead to isolation and inequality.

Data security. As digitization increases, many regulatory and legal issues arise [56]. As with previous network environments, the metaverse must consider data privacy protection when building next-generation networks [57]. Processes and protocols to govern anomalous behavior, such as cyber-bullying and financial dealings, especially when virtual currencies become convertible in the real world, also need to be investigated. With the advent of the metaverse, the amount of personal data collected will be considerable. In the future, multiple companies may collaborate to create one or more metaverses. As a result, companies may need to make significant technology investments to ensure the privacy and security of the metaverse [58].

Resource consumption. Research has shown that supporting digital technology infrastructure and the subsequent accumulation of a carbon footprint requires significant amounts of energy [59]. As the application of virtual intelligence in the travel industry grows, data needs will enhance. This can increase competition for already scarce resources [60]. Over-reliance on virtual digital spaces may lead to over-consumption when people engage in virtual experiences, resulting in more energy consumption from technological facilities.

Digital issues such as addiction, security, and resources need to be given high priority and digital governance by destinations and governments. Governments need to set up the legislative framework for successful metaverse use by customers and providers. Local destinations and governments need to act as a supervisory function to improve the credibility of travelers.

5.6. Business models

Adapting to metaverse technology requires tourism organizations to rethink traditional business models, embrace technological advancements, and prioritize customer-centric and sustainable practices. These changes will not only help in recovering post-pandemic but also position organizations for future growth and innovation

Hybrid Tourism Experiences. Tourism organizations can integrate metaverse technologies to create hybrid experiences that blend virtual and physical elements. For instance, virtual previews of destinations, augmented reality-enhanced tours, and post-visit digital engagement can complement traditional tourism offerings [50].

Enhanced Customer Personalization. By utilizing the data-driven capabilities of the metaverse, organizations can offer more personalized travel experiences. This includes tailored recommendations, virtual concierge services, and immersive experiences that reflect individual preferences and behaviors, enhancing customer satisfaction and loyalty [16].

New Revenue Streams. The metaverse opens up novel revenue opportunities beyond physical travel constraints. Virtual tourism can include digital souvenirs or subscription-based access to exclusive virtual content and events. These offerings can provide additional revenue during off-peak seasons or in response to travel restrictions.

Partnerships and Collaboration. To leverage metaverse technologies, tourism organizations should consider forming partnerships with tech companies, content creators, and other industries such as gaming and entertainment. These collaborations can bring in technical expertise and creative content, vital for creating engaging and innovative virtual experiences [61].

Sustainability and Accessibility. The metaverse can help address sustainability concerns by offering alternatives that require fewer physical resources and reduce environmental impact [62].

Training and Development. As metaverse technologies become integral to tourism, there is a need for ongoing staff training and development to manage these new tools effectively. Investing in human capital will be crucial for organizations to adapt sustainably [63].

6. Discussion and future direction

6.1. Long-term effects on traditional tourism practices

Integration of Digital and Physical Experiences. As metaverse technologies become more mainstream, we can anticipate a blending of virtual and real-world tourism experiences. Traditional practices may evolve to incorporate digital elements that enhance physical travel, such as augmented reality tours at historical sites or virtual reality pre-tours that help travelers decide their actual travel plans.

Customization and Personalization. The metaverse allows for personalized travel experiences based on user preferences, potentially shifting the focus of traditional tourism providers towards tailored offerings. This could lead to a transformation in how services are marketed in the tourism industry.

Sustainability Impact. Virtual tourism could alleviate some pressures on over-touristed destinations by offering alternative experiences that are less resource-intensive. Over time, this could lead to shifts in tourist flows and help with the preservation of sensitive environments and cultural sites.

6.2. Long-term effects on tourism destinations

Economic Diversification. Destinations that traditionally rely on physical tourism might develop new revenue streams through virtual tourism experiences, reducing economic dependence on actual visitor numbers. This could also help in managing seasonal fluctuations in tourist arrivals.

Competitive Differentiation. Destinations need to differentiate themselves not only through natural and cultural offerings but also through unique virtual experiences. This could lead to increased investment in creative industries, fostering a new tourism ecosystem.

Cultural Representation and Accessibility. The metaverse provides an opportunity to represent destinations in nuanced ways to a global audience, enhancing cultural appreciation and understanding. Moreover, it makes destinations accessible to people who may not be able to travel physically due to financial, health, or mobility constraints.

6.3. Impact on customer perceptions

Enhanced Engagement. The integration of metaverse technology in tourism offers immersive and interactive experiences that are more engaging than traditional digital offerings. This can lead to enhanced perceptions of value and satisfaction, as customers can explore destinations virtually, interact with digital content, and personalize their experiences in ways that were previously not possible.

Increased Expectations. As customers become accustomed to the enriched experiences provided by the metaverse, their expectations for convenience, entertainment, and personalization in tourism services are likely to increase. This shift may pressure traditional tourism providers to innovate continually to meet these evolving demands.

Trust and Security Concerns. While the metaverse presents new opportunities, it also raises concerns about data privacy and security. How tourism businesses address these issues can affect customer trust and their willingness to engage with metaverse-based tourism products.

6.4. Impact on customer behaviors

Shifts in Travel Planning. With the ability to explore destinations virtually, customers might change how they plan and book travel. For instance, virtual tours could influence decisions on where to travel, leading to potentially different choices compared to traditional decision-making processes.

Increased Frequency of Interaction. Metaverse platforms allow for continuous interaction with tourism content, which can keep customers engaged with a brand throughout the year, not just during actual travel periods.

Diversification of Tourism Experiences. The metaverse enables the creation of

virtual tourism experiences that might not be feasible in the real world due to cost, accessibility, or sustainability issues. As a result, customers might increasingly engage in hybrid tourism experiences that combine both physical and virtual elements.

7. Conclusion

This research demonstrates that metaverse technology significantly transforms the tourism industry by innovating traditional practices and enhancing tourist experiences. Findings indicate that applications such as digital eco-tours, museums, and cultural performances fundamentally expand tourism's operational scope and engage tourists more deeply through personalized and interactive offerings. Moreover, the study highlights the critical need for tourism organizations to adapt their management strategies to effectively integrate metaverse technology. This includes revising customer relations, marketing, and business models to exploit the metaverse's dynamic capabilities fully.

The impact of the metaverse on customer perceptions and behaviors necessitates that tourism operators anticipate and respond to changing expectations with agile and forward-thinking strategies. The integration of virtual and physical experiences should be a priority, ensuring inclusivity and adherence to ethical standards.

As the sector evolves post-pandemic, strategically embracing metaverse technology will be key to the industry's resilience and growth, shaping future travel experiences and setting new standards in tourism management.

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