Chapter 12
Combining Digital Twin and Metaverse for Immersive Marketing Experiences

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ABSTRACT

This research examines the integration of digital twins and the metaverse in marketing, a new approach that creates interactive and personalized experiences for users. Using digital twins, brands can create detailed customer profiles and use this data to improve user experiences in the metaverse. This integration allows brands to optimize their marketing strategies and create immersive digital experiences using real-time data. The research also examines the ethical considerations, privacy issues, technical challenges, and future trends of this approach and provides solutions for its effective exploitation.

1- INTRODUCTION

In the era of digital transformation, the boundaries between the physical and virtual worlds are rapidly blurring. These changes have provided marketers with unprecedented opportunities to create interactive, personalized, and immersive ex-

periences for customers. Among them, two prominent technologies (digital twins and metaverse) play a key role in shaping the future of marketing.

Digital twins, as a digital model of a physical object or system, enable the simulation, monitoring, and optimization of processes in real time. By collecting real-time data from various sources, this technology provides an accurate representation of the current situation and future predictions. On the other hand, metaverse, as a 3D and interactive virtual space, provides an environment where users can interact through their avatars and gain diverse experiences.

The combination of these two technologies offers unique opportunities for marketing. Using digital twins, brands can create an accurate representation of their products or services in the metaverse and engage users in interactive and personalized experiences. This approach not only improves the user experience, but also allows for the collection of valuable data on customer behavior and preferences.

Research shows that the digital twin market is growing rapidly and is expected to reach a value of $110.1 billion by 2028, representing a compound annual growth rate of 61.3% (Yordanova & Nozari, 2025). This growth reflects the increasing demand for accurate and real-time simulations across various industries. Similarly, the metaverse is also expanding as a virtual space, and brands are looking for ways to effectively participate in this space.

The integration of digital twins and the metaverse in marketing allows for the creation of interactive and personalized experiences that can increase customer engagement and improve loyalty. For example, brands can create virtual stores where users can view and interact with products in 3D, or even try digital versions of products before purchasing them in person.

However, this integration also brings challenges. Issues related to privacy, data security, and informed user consent are among the main concerns in this area. Brands need to ensure that user data is collected and used responsibly and securely, and that users are aware of how their data is being used.

In addition, technological infrastructure also plays a significant role in the success of this integration. To fully exploit the capabilities of digital twins and the metaverse, advanced infrastructures such as the Internet of Things (IoT), artificial intelligence (AI), augmented reality (AR), and virtual reality (VR) are needed. Together, these technologies can create immersive and interactive experiences for users.

Ultimately, the integration of digital twins and the metaverse in marketing provides unique opportunities for brands to create innovative and interactive experiences for customers. However, to fully exploit these opportunities, there is a need for a deep understanding of the related technologies, responsible data management, and the development of appropriate infrastructure. This research examines this integration and its implications for digital marketing, and provides solutions for its effective exploitation.

2- UNDERSTANDING DIGITAL TWINS AND THE METAVERSE

Digital twins and metaverses are two fundamental concepts in the modern digital world, both of which focus in some way on the creation and management of digital experiences. Although seemingly independent, these two concepts are synergistic and can be combined to provide users with immersive and personalized digital experiences. This section takes a closer look at these two concepts and how they relate to each other.

2-1 Digital Twin: Concept and Applications

A digital twin is defined as an accurate and dynamic digital model of a physical or non-physical system that can be updated in real time with real-time data. The concept was initially applied in the manufacturing and engineering industries, but gradually found its way into other areas such as health, energy, smart cities, and even marketing (Movahed, Movahed, & Nozari, 2024). By collecting and processing real-time data from sensors and Internet of Things (IoT) devices, a digital twin enables modeling and simulation of the behavior of complex systems.

A digital twin consists of three main components:

- Physical or real model: This part includes the actual physical object, process, or system that is to be simulated.
- Digital version: This part includes the virtual or digital model of the physical object that is dynamically updated with real data.
- Data communication: This component includes the connection between the physical object and its digital version, usually through sensors, IoT systems, and data networks (Nozari, 2025).

One of the key benefits of digital twins is the ability to monitor and optimize systems in real time. This technology can simulate different conditions, predict system performance, and provide optimal solutions to improve efficiency. For example, in the field of marketing, digital twins can be used to create digital profiles of customers and monitor their behavior in real time. These profiles can include information such as purchasing preferences, online interactions, and past behaviors. Then, based on this data, targeted and personalized marketing campaigns are designed (Movahed, Movahed, & Nozari, 2024).

2-2 Digital Twin Applications in Marketing

In the field of marketing, digital twins can play an important role in improving customer experience and optimizing marketing strategies. Some of its key applications include the following:

- Content personalization: Using digital twins, brands can personalize their content and advertising messages based on the characteristics and preferences of each customer.
- Customer behavior prediction: By analyzing digital twin data, brands can predict future customer behaviors and improve their marketing strategies.
- User experience improvement: Digital twins can create a better user experience for customers by providing personalized recommendations and relevant content (Nozari, 2025).

2-3 Metaverse: Concept and Evolution

A metaverse is an interactive and immersive digital environment in which users can interact with each other and with their surroundings through their digital avatars. The concept is defined as a permanent and persistent virtual space that can include 3D environments, virtual reality (VR) experiences, augmented reality (AR) and even mixed reality (Rane, Choudhary, & Rane, 2023). The metaverse has become one of the key concepts in the digital world in recent decades, thanks to technological advances in the fields of virtual reality, artificial intelligence, the Internet of Things and blockchain.

A metaverse includes the following features:

- Interactive and 3D environments: Users can move around virtual 3D environments, communicate with others, and interact with digital objects.
- Personalized avatars: Each user can create their own digital avatar and personalize it with desired features.
- Digital economy: The metaverse typically includes an independent digital economy where users can buy and sell digital assets such as cryptocurrencies, non-fungible tokens (NFTs), and virtual items (Najafi, Nozari, & Edalatpanah, 2022).
- Multiple experiences: The metaverse includes a variety of environments that can include virtual games, educational environments, workspaces, and even virtual concerts.

2-4 The Evolution of the Metaverse and Its Impact on Marketing

With the emergence of metaverse platforms such as Decentraland, Roblox, and Meta (Facebook), brands have gradually realized the importance of this space for marketing. The metaverse allows brands to create immersive and interactive experiences for customers and build deeper connections with them. For example, brands can create virtual exhibitions, hold interactive events, and even launch virtual stores where customers can digitally experience products (Nozari, 2025).

In the metaverse, users can freely move around virtual spaces and interact with brands directly. This allows brands to create personalized and unique experiences for each user. For example, a fashion brand can launch a virtual fashion show in the metaverse where users can participate live and try on digital clothes (Wallace, 2023).

2-5 The Connection Between Digital Twins and the Metaverse

Digital twins and the metaverse can work together to create immersive and personalized marketing experiences for users. Digital twins can serve as the foundation for personalizing content and metaverse experiences. For example, a brand can use digital twin data from users to design personalized metaverse experiences. These experiences can include interactive exhibitions, live events, and even product simulations (Nozari, Szmelter-Jarosz, & Ghahremani-Nahr, 2021).

The metaverse can also serve as an interactive platform for experiencing and using digital twins. For example, users can access and review digital versions of products through their avatars in the metaverse. This synergy between digital twins and the metaverse can help brands create interactive, engaging, and lasting marketing experiences for users (Fallah & Nozari, 2021).

3- DIGITAL TWIN INTEGRATION WITH THE METAVERSE FOR MARKETING

Digital Twin Integration with the Metaverse is an innovative approach in digital marketing that enables the creation of interactive and personalized experiences for customers. By combining accurate digital twin data with interactive and immersive environments of the Metaverse, this approach allows brands to create marketing experiences tailored to the characteristics of each user. In this section, we will examine the conceptual framework of this integration, its application scenarios, and its benefits.

3-1 Conceptual Framework for Merging Digital Twins and Metaverse

The integration of digital twins and metaverse is based on a conceptual framework in which the digital twin acts as a data layer and the metaverse acts as an interactive platform for displaying and using this data. As a digital view of a system, product, or even a user, the digital twin collects and stores accurate and up-to-date information from the real world. This data can include information such as customer preferences, purchase history, online behavior, and even environmental data such as temperature, humidity, or the status of physical devices (Buhalis, Leung, & Lin, 2023). This data is collected and processed in real time using the Internet of Things (IoT) and artificial intelligence systems.

On the other hand, the metaverse acts as a virtual and interactive environment that users can enter and interact with the environment and other users through their digital avatars. In this environment, the digital twin data can be displayed to users in a visual and interactive way. For example, a virtual store can use digital twin data of customers to personalize products and services. Users can view products in 3D, try them on, and even receive personalized recommendations based on their preferences (Oskounejad & Nozari, 2024).

In this framework, the connection between the digital twin and the metaverse is established through an intelligent data layer that continuously shares information between the digital twin system and the metaverse environment. This layer can include artificial intelligence and machine learning algorithms that analyze data, predict user behavior, and optimize the user experience. For example, a fashion brand can use digital twins to identify the sizes, colors, and styles of each user and then create personalized fashion shows in the metaverse that users can attend live (Al Zami, Shaon, Quy, & Nguyen, 2025). This approach not only improves the user experience, but also allows brands to continuously optimize their marketing strategies based on real, real-time data.

3-2 Application Scenarios of Digital Twin and Metaverse Integration in Marketing

Digital twin and metaverse integration can be used in various scenarios to improve customer experience and optimize marketing strategies. One of the most important scenarios is to simulate a personalized shopping experience. In this scenario, users can enter virtual stores through their digital avatars and browse different products. The users' digital twin data, such as purchase history, color and style preferences, are displayed in real time in the metaverse, allowing users to view products tailored

to their tastes (Nozari, Tavakkoli-Moghaddam, & Dolgui, 2024). This experience can include clothing, electronics, home appliances, and even cars.

In another scenario, brands can use digital twins to design interactive marketing campaigns in the metaverse. For example, a cosmetics brand can launch a virtual showroom where users can try on different products through their avatars. The exhibition can be dynamically personalized with each user's digital twin data, and product recommendations can be displayed based on the user's skin type, color preferences, and purchase history (Han et al., 2022). This approach not only improves the user experience, but also helps brands deliver their marketing content in a targeted and personalized manner.

Furthermore, the integration of digital twins and the metaverse can be used to design interactive experiences for brands in virtual events. For example, brands can host conferences, exhibitions, and virtual live events in the metaverse, where users can meet brand representatives, products, and services in person. The digital twin data of users can be used to personalize these events and provide targeted offers. This approach allows brands to establish deeper connections with customers and create lasting experiences (Fallah & Nozari, 2021).

3-3 Benefits of Integrating Digital Twins and the Metaverse in Marketing

Integrating digital twins and the metaverse in marketing has several benefits that can help brands create more effective and engaging marketing experiences. One of the most important benefits of this approach is the possibility of deep personalization of the user experience. Brands can use digital twin data to design their marketing experiences for each user individually. This includes product recommendations, promotional content, and even special discounts that are tailored to each user's characteristics and preferences (Ghahremani-Nahr, Nozari, & Szmelter-Jarosz, 2024).

Another advantage of this approach is real-time interaction with customers. Brands can use the metaverse to create interactive and live experiences where users can interact directly with products and services. These interactions can include virtual exhibitions, live events, interactive stores, and even promotional games. These interactive experiences not only help improve the user experience, but also enable brands to collect real-time data on customer behavior and use this data to optimize their marketing strategies (Nozari, Abdi, & Rafiei, 2025).

Finally, the integration of digital twins and the metaverse allows brands to continuously evaluate and improve the performance of their marketing strategies. Brands can use digital twins data to analyze customer behavior and identify the strengths and weaknesses of their marketing campaigns. In addition, brands can use metaverse data to analyze the user experience and identify areas for improvement. This data-

driven approach helps brands dynamically optimize their marketing strategies based on data and create lasting experiences for customers (Mourtzis, 2023).

Figure 1 schematically illustrates the digital twin and metaverse integration framework for digital marketing. It shows how digital twin data can be used to personalize metaverse experiences and create immersive marketing experiences.

Figure 1. Digital Twin and Metaverse Integration Framework for Digital Marketing
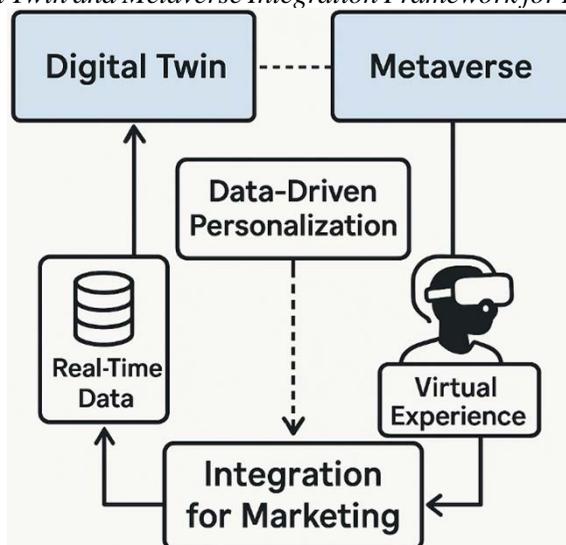
This framework not only helps improve user experience, but also enables brands to optimize their marketing strategies using real-time data.

4- TECHNICAL DESIGN AND IMPLEMENTATION

Integrating digital twins and the metaverse into marketing requires a detailed and structured technical design that includes various components such as data collection, information processing, and display of interactive experiences. This section examines the system architecture, technology stack, and user experience design principles that are essential for creating a digital twin and metaverse-based marketing system. This approach not only helps create immersive and personalized experiences for users, but also allows brands to optimize their marketing strategies in real time.

4-1 Digital Twin and Metaverse Integration Architecture

The architecture of this system consists of three main layers: the data layer, the processing layer, and the user experience layer. In the data layer, data related to users, products, and physical environments is collected. This data can include user profile information, purchase history, data from Internet of Things (IoT) sensors, and environmental information such as temperature and humidity. This data is continuously and in real time sent to the digital twin system, which acts as a dynamic digital view of users and systems. The collected data is processed and analyzed using machine learning algorithms, and the results are used to design personalized experiences in the metaverse. The overall structure of this integration is shown in Figure 2.

Figure 2. Digital Twin and Metaverse Integration Framework for Digital Marketing
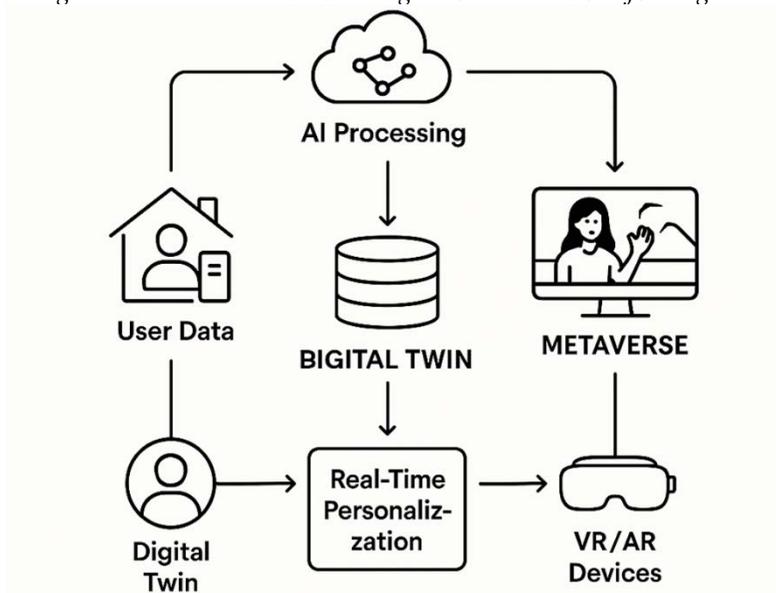
This framework shows how digital twin data can be transferred to the metaverse in real time and used to personalize the user experience. The data includes real-time information from users and the physical environment, which is then processed and displayed interactively in the metaverse.

The processing layer includes artificial intelligence and machine learning engines that analyze and process the digital twin data. These processes can include predicting user behavior, identifying their preferences, and providing personalized recommendations. For example, deep learning algorithms can use digital twin data to predict which products users are interested in and automatically display these

products in the metaverse environment. This layer also includes security systems to protect user data and ensure their privacy. These systems can include data encryption, two-factor authentication, and advanced security protocols.

Finally, the user experience layer acts as the interface between the user and the system. This layer includes the metaverse environment, which users can enter through their digital avatars and interact with the environment and other users. These environments can include virtual stores, interactive exhibitions, live events, and educational spaces. The users' digital twin data is displayed in real time in these environments, creating personalized experiences for each user. This layer also includes interactive systems such as motion controls, audio systems, and even virtual and augmented reality (VR/AR) devices that allow users to interact with the environment in an immersive way.

4-2 Technology Stack and Recommended Tools

Implementing a digital twin and metaverse integration system requires the use of a comprehensive technology stack that includes hardware, software, and development tools. On the hardware side, the use of Internet of Things (IoT) devices is essential to collect real-time data from users and the physical environment. These devices can include temperature, humidity, pressure, geolocation, and even biometric sensors to measure users' physiological parameters. In addition, virtual and augmented reality devices such as VR headsets, AR glasses, and 3D displays are used to display the metaverse environment.

On the software side, the digital twin system uses a cloud platform to store and process data. This platform can include cloud technologies such as AWS, Microsoft Azure, or Google Cloud that provide features such as data storage, parallel processing, and real-time analytics. To create a metaverse environment, graphics engines such as Unity or Unreal Engine are used, which allow the design of interactive and realistic 3D environments. This structure and data flow are comprehensively shown in Figure 3.

Figure 3. Data flow and user experience in the digital twin and metaverse integration system
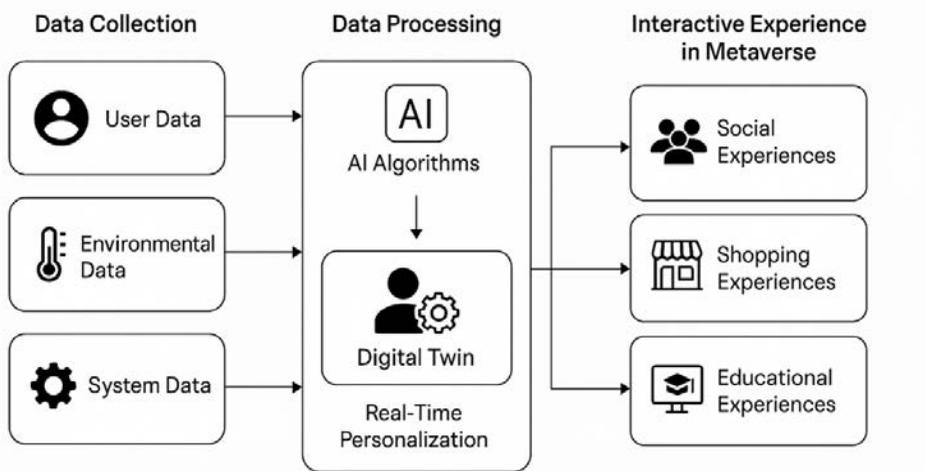
This diagram shows how data is collected from users and the physical environment and then processed into personalized experiences in the metaverse. These experiences can include social experiences, shopping experiences, and educational experiences.

4-3 Principles of User Experience Design in the Metaverse Environment

One of the most important factors in the success of integrating digital twins and the metaverse is designing an interactive and personalized user experience that attracts users. This experience should be designed in a way that users interact with the metaverse environment naturally and without feeling complicated. The first principle of user experience design is to create a simple and user-friendly user interface. This interface should include interactive menus, gesture controls, and visual displays that users can easily use. For novice users, the possibility of providing interactive guides and displaying educational tools should also be considered.

In addition, the user experience should be designed in a way that is personalized. This personalization can include displaying products and services tailored to each user's characteristics and preferences, providing targeted suggestions, and even changing the metaverse environment based on user behavior and preferences. For example, users can view virtual stores whose products are filtered based on their interests. Additionally, the ability to change digital avatars and personalize their appearance should be provided to increase the sense of identification and interaction of users with the metaverse environment.

Finally, the user experience in the metaverse should be interactive and immersive. This interaction can include users interacting with digital objects, communicating with other users, and even participating in virtual live events. These interactive experiences not only allow users to actively engage with the metaverse environment, but also help brands build deeper connections with customers.

5- PRACTICAL APPLICATIONS OF INTEGRATING DIGITAL TWINS AND METAVERSE IN MARKETING

The integration of digital twins and the metaverse in marketing has vast potential and can create completely new and engaging experiences for customers. This approach not only improves the personalization of the user experience, but also allows brands to optimize their marketing strategies using real-time data. Practical applications of this integration in marketing include personalized shopping experiences, interactive virtual exhibitions, live events, immersive training, and even customer relationship management in digital environments. Each of these applications can directly or indirectly lead to increased customer engagement, improved user experience, and increased sales.

One of the most important applications of the integration of digital twins and the metaverse is the creation of personalized shopping experiences in virtual environments. For example, brands can create virtual stores in the metaverse that users can enter through their avatars and view and review different products. The digital twin's data, such as purchase history, color preferences, size, and style preferences, is fed into the system in real time, and the displayed products are personalized based on this data. This approach not only makes the shopping experience more engaging for users, but also helps brands provide targeted and personalized recommendations. For example, users can view a virtual fashion store with products filtered based on their color and style preferences, and even have the option to try on clothes on their digital avatars.

Interactive virtual showrooms are another practical application of this integration. Brands can host virtual showrooms where users can participate live and learn about the brand's products and services. These showrooms can include interactive booths that users can enter and view product information. Additionally, brands can use digital twin data to personalize the showroom experience for each user. For example, an automotive brand could create a virtual showroom where users can view different car models and configure them based on their personal preferences. These showrooms could be interactive, allowing users to ask questions about the car's features, start the engine, and even virtually test drive it.

Live events in the metaverse are another practical application of digital twin and metaverse integration in marketing. Brands can host virtual events such as concerts, workshops, webinars, and Q&A sessions in the metaverse. Users can participate in these events using their avatars and interact live with brands and other users. The digital twin data of users can be used to personalize the event experience. For example, in a virtual event related to cosmetics, the brand can recommend relevant products to each user based on their skin type and color preferences. These events not only allow brands to directly communicate with customers, but also help them collect valuable data on user behavior and preferences.

Immersive training is another application of digital twin and metaverse integration that can be used in various fields such as product training, employee training, and even customer training. Brands can create virtual learning environments where users can learn about the brand's products and services. These trainings can include interactive simulations where users can actually work with the products. For example, a home appliance brand can create a virtual learning environment where users can learn how to use products such as refrigerators, washing machines, or cooking appliances. These trainings can be interactive, where users can examine the different parts of the devices and learn how they work.

In addition, the integration of digital twins and the metaverse can also be used for customer relationship management (CRM) in virtual environments. Brands can deploy their sales and support representatives in metaverse environments where users can interact with them live. These agents can help users solve their problems, answer their questions, and even introduce them to new products and services. Digital twin data of users can help agents create personalized experiences for each user. For example, if a user has purchased a product in the past and had a problem with it, the agent can automatically learn about this information and provide the user with appropriate solutions.

These practical applications demonstrate that the integration of digital twins and the metaverse can enable brands to create personalized, interactive, and immersive experiences for users. These experiences not only help improve the user experience, but also help brands continuously collect valuable data on user behavior and preferences, which they can use to optimize their marketing strategies. This data-driven approach allows brands to dynamically tailor their marketing experiences to users' needs and build deeper connections with customers.

6- ETHICAL CONSIDERATIONS AND PRIVACY ISSUES

In addition to offering unique opportunities for creating personalized and interactive experiences, the integration of digital twins and the metaverse in marketing

also brings with it ethical challenges and privacy issues. These challenges arise because these technologies are heavily dependent on the collection, processing, and analysis of user data. Data that may include sensitive and personal information about users. This data includes users' identity information, online behaviors, personal preferences, and even biometric data (Yordanova & Nozari, 2025). Inappropriate use of this data or lack of adequate protection of it can lead to violations of users' privacy and raise serious ethical concerns. Therefore, it is essential to examine and manage these challenges to ensure the responsible and ethical use of digital twins and the metaverse in marketing.

One of the most important ethical considerations in this context is transparency in the collection and use of user data. Brands should clearly inform users about what data is being collected from them, how it is processed, and for what purpose it is used. This transparency should not only be reflected in the brands' privacy policies, but also explained in plain, understandable language to users (Nozari, Abdi, & Jahangard, 2025). For example, if a brand uses users' digital twin data to personalize metaverse experiences, users should be informed about how this data is being collected, how it is stored, and how it is being used to provide personalized offers. This transparency allows users to make an informed decision about whether they want to share their data.

Protecting user data is another important ethical dimension in this context. In an environment where digital twins and metaverses access and process user data in real time, maintaining the security of this data is of particular importance. Brands should use strong security protocols to protect user data. These protocols can include data encryption, two-factor authentication, and data access management systems. In addition, brands should use security monitoring and control systems that allow them to continuously monitor the security of user data and take prompt action if any threats or security breaches are identified (Prabhakaran et al., 2025). These measures not only help protect user data, but also build trust between users and brands.

The issue of informed consent of users is also a fundamental principle in privacy. Brands should ensure that users are sharing their data with full and informed consent. This consent should be provided in a clear and plain language, and users should be able to withdraw their consent at any time. For example, if a user does not want their digital twin data to be used to personalize metaverse experiences, they should be able to opt out. This consent should be actively collected, meaning that users must voluntarily and consciously express their consent, rather than being assumed to have consented (Nozari & Samadi, 2025).

In addition, the use of artificial intelligence and machine learning algorithms to analyze user data can also raise ethical challenges. These algorithms can automatically analyze user data and identify patterns of behavior. While this approach can help brands create personalized experiences for users, it can also lead to concerns

about discrimination or bias in data analysis. Brands should ensure that their algorithms are designed in a fair and unbiased manner and are continuously reviewed and evaluated to ensure they are operating properly and ethically (Chatterjee et al., 2024). This review could include evaluating algorithms to identify any unfair discrimination or inappropriate prioritization of some users.

Another important aspect of privacy protection is data anonymization. Brands should ensure that user data is stored and processed anonymously, and that no information that could directly reveal the user's identity is made available. This can include using encryption techniques, separating identity data from analytics data, and even using federated learning models to process data (Panagiotakopoulos, Marentakis, Metzitakos, Deliyannis, & Dedes, 2022). This approach not only helps protect user privacy, but also allows brands to use user data in a safe and ethical manner to improve the user experience.

Finally, it is essential to comply with privacy laws and regulations in different geographies. Brands should comply with the General Data Protection Regulation (GDPR) in the European Union, the California Consumer Privacy Act (CCPA) in the United States, and other local privacy regulations. These laws give users the right to access, rectify or delete their data, and even object to the processing of their data (Bonta, 2022). Brands should use these laws as a guide to designing their systems to prevent breaches of user privacy.

Overall, the responsible use of digital twins and the metaverse in marketing means that brands should always put the interests of users first. This includes avoiding the use of psychological manipulation techniques to persuade users to buy products, avoiding the dissemination of false or misleading information, and providing transparent and ethical marketing experiences. Brands should use advanced technologies to improve the user experience, but they should always ensure that these technologies are used responsibly and ethically.

7- FUTURE TRENDS AND RESEARCH DIRECTIONS

The integration of digital twins and metaverse in marketing is an emerging and dynamic field that continues to evolve, and there are many opportunities for development and research in this field. With the advancement of digital technologies and the expansion of the use of artificial intelligence, the Internet of Things (IoT), virtual reality (VR), and augmented reality (AR), user expectations of digital experiences are changing rapidly. In the meantime, digital twins and metaverse as two key concepts can enable brands to create personalized, interactive, and immersive experiences

for users. However, to fully exploit these potentials, there is a need to develop new technologies, improve infrastructure, and conduct deeper research in this area.

One of the most important future trends in this field is the use of artificial intelligence to improve the capabilities of digital twins and metaverse. Artificial intelligence can automatically analyze user data and predict their behavior. This technology can use deep learning algorithms and neural networks to create more accurate models of user behavior and improve personalized experiences. For example, AI systems can analyze users' digital twins in real time and provide personalized recommendations to users based on these analyses. This trend can help brands create dynamic user experiences that are tailored to users' needs.

Along with AI, augmented reality and virtual reality technologies are also considered as key drivers in the development of the metaverse and interactive digital experiences. Advances in AR and VR technologies allow brands to create more realistic virtual environments that users can interact with in an immersive way. These environments can include virtual stores, interactive exhibitions, live events, and even interactive training. In addition, with the development of Mixed Reality (MR) technologies, it is possible to combine real and virtual environments simultaneously, which can elevate user experiences to a higher level. This trend allows brands to seamlessly combine digital and physical experiences.

Another trend is the expansion of the use of blockchain and non-fungible tokens (NFTs) in the metaverse. As a decentralized and secure technology, blockchain can help brands create and offer unique digital assets to users. These assets can include digital products, virtual clothing, digital art, and even virtual real estate. For example, a fashion brand could create a collection of digital clothing in the form of NFTs that users can purchase and use in the metaverse. Additionally, blockchain can help maintain user security and privacy in the metaverse, as user information is stored decentralized and can only be accessed with their consent. This approach could lead to the creation of an independent digital economy in the metaverse where users can buy and sell their digital assets.

Another important research direction in this field is the development of dynamic and intelligent digital twin models. As a digital view of physical systems or users, a digital twin can be dynamically updated using real-time data. However, to create accurate and realistic models, it is necessary to develop advanced machine learning algorithms and neural networks that can automatically analyze user data and update digital twin models. These models can help brands predict user behavior more accurately and create more personalized experiences. For example, a dynamic digital twin model can analyze users' environmental and behavioral data to create personalized experiences for them that are in line with their current situation.

Another important research focus is to investigate the social and psychological effects of integrating digital twins and the metaverse on users. As the use of the

metaverse expands, users are gradually spending more time in virtual environments, which can have numerous psychological and social impacts. Research can examine the impact of the metaverse on users' mental health, social relationships, digital identity, and even their consumption behaviors. This research can help brands design responsible and ethical user experiences that not only improve the user experience, but also support users' mental health and well-being.

Also, research on standardizing and developing security protocols to protect user data in the metaverse is of particular importance. Given that the metaverse is heavily dependent on the collection and processing of user data, protecting user privacy and preventing misuse of their data has become a fundamental challenge. Research can help develop advanced security protocols such as end-to-end encryption, multi-factor authentication systems, and data anonymization models. These protocols can help brands use user data safely and responsibly.

Finally, another important research direction is to examine business models and marketing strategies based on digital twins and the metaverse. Brands can use these technologies to create new business models that are based on interactive and personalized experiences. These models can include virtual stores, interactive exhibitions, live events, and even educational experiences. Research can examine the effectiveness of these business models, analyze user behavior in these environments, and identify the best marketing strategies to attract and retain customers.

These future trends and research directions show that digital twins and the metaverse in marketing are still evolving and there are unique opportunities for development and innovation in this field. By conducting deeper research and developing new technologies, brands can create more interactive, personalized, and ethical digital experiences for users, which not only helps improve the user experience, but also leads to business growth and success.

8- CONCLUSION

The integration of digital twins and metaverse in marketing as a new and transformative approach enables the creation of interactive, personalized, and immersive experiences for users. By combining accurate and real-time digital twin data with virtual and interactive metaverse environments, this approach allows brands to dynamically optimize their marketing strategies according to the characteristics and needs of each user. This system not only improves the user experience, but also helps brands establish deeper and more meaningful connections with their customers and collect valuable data on user behavior and preferences.

This chapter began by examining the concepts of digital twins and metaverse and then examined how these two technologies can be integrated in marketing. The

conceptual framework of this integration showed how digital twin data can be displayed in real-time in the metaverse and create personalized experiences for users. This approach not only allows brands to create more interactive and engaging digital experiences, but also helps them use real-time data and analytics to optimize their marketing strategies. This system allows brands to continuously improve customer experiences and adjust their marketing strategies based on real-time user behavior using real-time data.

Furthermore, a review of the practical applications of this approach showed that the integration of digital twins and metaverse can be used in various areas, including personalized shopping experiences, virtual exhibitions, live events, interactive training, and even customer relationship management. These applications not only improve the user experience, but also allow brands to establish interactive and meaningful connections with their customers and collect valuable data on user behavior. However, this approach also comes with ethical challenges and privacy issues. Brands must ensure that user data is collected, processed, and stored responsibly and securely, and that users share their data with full consent and awareness.

The review of future trends and research directions also revealed that digital twins and the metaverse continue to evolve, and there are unique opportunities for development and innovation in this area. Using artificial intelligence to improve personalization capabilities, developing dynamic digital twin models, using augmented and virtual reality to create immersive experiences, and even using blockchain to maintain user security and privacy are among the trends that can help these technologies grow and progress. Also, conducting deeper research into the social and psychological effects of these technologies on users and examining business models based on these approaches can help develop practical and responsible solutions in this area.

Ultimately, the integration of digital twins and the metaverse in marketing as a data-driven and interactive approach enables the creation of dynamic, personalized, and immersive digital experiences for users. This approach not only improves the user experience and increases user engagement, but also allows brands to optimize their marketing strategies using real-time data and analytics. However, success in using this approach requires responsible design and implementation, ethical considerations, and user privacy. Brands should always use advanced technologies to improve the user experience, but at the same time, they must ensure that these technologies are used responsibly and ethically.

REFERENCES

Al Zami, M. B., Shaon, S., Quy, V. K., & Nguyen, D. C. (2025). Digital Twin in Industries: A Comprehensive Survey. *IEEE Access : Practical Innovations, Open Solutions*.

Aloqaily, M., Bouachir, O., Karray, F., Al Ridhawi, I., & El Saddik, A. (2022). Integrating digital twin and advanced intelligent technologies to realize the metaverse. *IEEE Consumer Electronics Magazine*, *12*(6), 47–55. DOI: 10.1109/MCE.2022.3212570

Bonta, R. (2022). California consumer privacy act (CCPA). Retrieved from State of California Department of Justice: https://oag. ca. gov/privacy/ccpa.

Buhalis, D., Leung, D., & Lin, M. (2023). Metaverse as a disruptive technology revolutionising tourism management and marketing. *Tourism Management*, *97*, 104724. DOI: 10.1016/j.tourman.2023.104724

Chatterjee, P., Das, D., Rawat, D. B., Ghosh, U., Banerjee, S., & Al-Numay, M. S. (2024). Digital Twins and Blockchain Fusion for Security in Metaverse-Driven Consumer Supply Chains. *IEEE Transactions on Consumer Electronics*, *70*(3), 5688–5697. DOI: 10.1109/TCE.2024.3477297

Deng, B., Wong, I. A., & Lian, Q. L. (2024). From metaverse experience to physical travel: The role of the digital twin in metaverse design. *Tourism Review*, *79*(5), 1076–1087. DOI: 10.1108/TR-05-2023-0315

Durana, P., Vochozka, M., Tucmeanu, A. I., & Tudosă, P. (2022). Digital Twin-enabled Industrial Internet of Things, Multi-Sensory Extended Reality and Immersive Holographic Imaging Technologies, and 3D Modeling and Virtual Simulation Tools across Blockchain-based Decentralized Metaverse Systems. Economics. *Management and Financial Markets*, *17*(4), 43–57.

Fallah, M., & Nozari, H. (2021). Neutrosophic mathematical programming for optimization of multi-objective sustainable biomass supply chain network design. *Computer Modeling in Engineering & Sciences*, *129*(2), 927–951. DOI: 10.32604/cmes.2021.017511

Fallah, M., & Nozari, H. (2021). Quantitative analysis of cyber risks in IoT-based supply chain (FMCG industries). *Journal of Decisions and Operations Research*, *5*(4), 510–521.

Ghahremani-Nahr, J., Nozari, H., & Szmelter-Jarosz, A. (2024). Designing a humanitarian relief logistics network considering the cost of deprivation using a robust-fuzzy-probabilistic planning method. *Journal of International Humanitarian Action*, *9*(1), 19. DOI: 10.1186/s41018-024-00163-8

Han, Y., Niyato, D., Leung, C., Kim, D. I., Zhu, K., Feng, S., Shen, X., & Miao, C. (2022). A dynamic hierarchical framework for IoT-assisted digital twin synchronization in the metaverse. *IEEE Internet of Things Journal*, *10*(1), 268–284. DOI: 10.1109/JIOT.2022.3201082

Kovacova, M., Oláh, J., & Popescu, G. H. (2022). Digital Twin simulation and modeling tools, deep learning object detection technology, and visual perception and sensor fusion algorithms in the metaverse commerce. Economics. *Management and Financial Markets*, *17*(3), 9–24.

Mourtzis, D. (2023). Digital twin inception in the Era of industrial metaverse. *Frontiers in Manufacturing Technology*, *3*, 1155735. DOI: 10.3389/fmtec.2023.1155735

Movahed, A. B., Movahed, A. B., & Nozari, H. (2024). Marketing 6.0 Conceptualization. In Advanced Businesses in Industry 6.0 (pp. 15-31). IGI Global.

Movahed, A. B., Movahed, A. B., & Nozari, H. (2024). Opportunities and challenges of marketing 5.0. Smart and Sustainable Interactive Marketing, 1-21.

Najafi, S. E., Nozari, H., & Edalatpanah, S. A. (2022). Investigating the key parameters affecting sustainable IoT-based marketing. In *Computational Intelligence Methodologies Applied to Sustainable Development Goals* (pp. 51–61). Springer International Publishing. DOI: 10.1007/978-3-030-97344-5_4

Nozari, H. (Ed.). (2025). *Dynamic and Safe Economy in the Age of Smart Technologies*. IGI Global. DOI: 10.4018/979-8-3693-4369-2

Nozari, H. (2025). Cognitive Targeting and Neuromarketing Applications in AI-Driven Digital Advertising. *Applied Innovations in Industrial Management*, *5*(2), 52–58. DOI: 10.63630/aiim.52.52

Nozari, H. (2025). NeuroTwinceutics™ as a Neuromorphic Digital Twin Model for Predictive and Personalized Pharmacotherapy. *Transformative Science*, *1*(1), 1–8.

Nozari, H., Abdi, H., & Jahangard, S. (2025). Quantum Cognitive Intelligence Network Q-CIN as a Transformative Framework for Industry 6.0. *ALL Bioscience*, *1*(1), 27–37.

Nozari, H., Abdi, H., & Rafiei, K. (2025). Edge Computing and Marketing in the Smart Economy: Processing Consumer Data in Real-Time. In Dynamic and Safe Economy in the Age of Smart Technologies (pp. 191-208). IGI Global Scientific Publishing.

Nozari, H., Rahmaty, M., & Szmelter-Jarosz, A. (2024). A framework for AIoT-based smart sustainable marketing system. In *Artificial Intelligence of Things for Achieving Sustainable Development Goals* (pp. 255–271). Springer Nature Switzerland. DOI: 10.1007/978-3-031-53433-1_13

Nozari, H., & Samadi, S. (2025). Digital Twin-Enhanced Sentiment Analysis for Targeted Marketing Optimization. In Dynamic and Safe Economy in the Age of Smart Technologies (pp. 121-138). IGI Global Scientific Publishing. DOI: 10.4018/979-8-3693-4369-2.ch008

Nozari, H., Szmelter-Jarosz, A., & Ghahremani-Nahr, J. (2021). The ideas of sustainable and green marketing based on the internet of everything—The case of the dairy industry. *Future Internet*, *13*(10), 266. DOI: 10.3390/fi13100266

Nozari, H., Szmelter-Jarosz, A., & Rahmaty, M. (2024). Smart marketing based on artificial intelligence of things (AIoT) and Blockchain and evaluating critical success factors. In *Smart and Sustainable Interactive Marketing* (pp. 68–82). IGI Global Scientific Publishing. DOI: 10.4018/979-8-3693-1339-8.ch005

Nozari, H., Tavakkoli-Moghaddam, R., & Dolgui, A. (2024, September). Analysis of Critical Success Factors of Sustainable and Resilient Aioe-based Supply Chain in Industry 5.0. In IFIP International Conference on Advances in Production Management Systems (pp. 76-90). Cham: Springer Nature Switzerland. DOI: 10.1007/978-3-031-65894-5_6

Oskounejad, M. M., & Nozari, H. (Eds.). (2024). *Advanced Businesses in Industry 6.0*. IGI Global. DOI: 10.4018/979-8-3693-3108-8

Panagiotakopoulos, D., Marentakis, G., Metzitakos, R., Deliyannis, I., & Dedes, F. (2022). Digital scent technology: Toward the internet of senses and the metaverse. *IT Professional*, *24*(3), 52–59. DOI: 10.1109/MITP.2022.3177292

Prabhakaran, A., Mahamadu, A. M., Adekunle, S., Manu, P., Booth, C. A., & Aigbavboa, C. (2025). 24 Towards a Metaverse Platform for Immersive Collaborative Design. Applications of Immersive Technology in Architecture, Engineering and Construction: A Handbook, 24.

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Rane, N., Choudhary, S., & Rane, J. (2023). Metaverse marketing strategies: enhancing customer experience and analysing consumer behaviour through leading-edge Metaverse technologies, platforms, and models. Platforms, and Models (November 3, 2023).

Sai, S., Prasad, M., Garg, A., & Chamola, V. (2024). Synergizing digital twins and metaverse for consumer health: A case study approach. *IEEE Transactions on Consumer Electronics*, *70*(1), 2137–2144. DOI: 10.1109/TCE.2024.3367929

Wallace, S. (2023). Digital Twin and Metaverse Technologies, Geospatial Simulation and Sensor Fusion Tools, and Object Perception and Motion Control Algorithms in Immersive Hyper-Connected Virtual Spaces. *Linguistic and Philosophical Investigations*, (22), 264–280.

Yang, W., Tan, F., Bai, Y., & Ryu, J. H. (2024, November). Exploring Experiential Marketing Strategies of Luxury Fashion Brands in the Metaverse: An In-Depth Analysis of Immersive Consumer Engagement. In International Conference on Services Computing (pp. 100-113). Cham: Springer Nature Switzerland.

Yordanova, Z., & Nozari, H. (2025). Harnessing Cyber-Physical Systems and Digital Twins for Industrial Innovation and Economic Resilience. In Dynamic and Safe Economy in the Age of Smart Technologies (pp. 33-48). IGI Global Scientific Publishing. DOI: 10.4018/979-8-3693-4369-2.ch003