

Next-generation museum: a metaverse journey into culture

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Abstract

Frame of the research: This research is placed within the framework of digital transformation and innovation management. Thanks to their ability to perform multiple functions simultaneously, next-generation technologies play a leading role in the value co-creation with the target market. Their implementation allows firms to revitalise their offer, making it more attractive and more effective.

Purpose of the paper: This research investigates the digital transformation of museums through the application of the metaverse to artworks and archeological artifacts. We focus on the metaverse's capacity to bring the museum concept into original and modern 3D contexts. Specifically, this article explores opportunities and challenges for museums committed to making the metaverse journey into culture particularly edutaining and fascinating for young people, especially Gen Z.

Methodology: Based on the digital transformation management literature, we apply our analysis to an exploratory case study. MetaSea™ is a pilot project aimed at creating a virtual marine museum to enhance underwater archaeological heritage. We also interview a digital entrepreneur, among the first in Italy to develop metaverse solutions. Data are collected through semi-structured interviews. We integrate the interviews with field observations at the Mori Art Museum, Tokyo.

Findings: The metaverse creates opportunities and challenges for museums, expanding the variety of cultural products in an original way. It supports museums in pursuing their edutainment goals, as it allows visitors to fully experience artworks and archaeological artifacts. With the metaverse, the process of value co-creation is transforming because involvement and participation are necessary, but not sufficient to live the multisensory experience. Finally, the next generation of museums brings Gen Z closer to learning about cultural heritage thanks to the possibility of living unprecedented experiences in an engaging and inclusive way.

Research limitations: Given the current state of metaverse technology, the research analyzes ongoing pilot projects. The paper is based on an exploratory case study of the early stage of metaverse application to museums. In addition to suffering from a lack of data, this research is difficult to generalize.

Practical implications: This paper provides a clearer picture of the metaverse as part of museums' digital strategies. It offers suggestions, guidelines, and initial solutions for the design of edutainment-oriented museums.

Originality of the paper: This study explores the opportunities and challenges of using the metaverse to transform museums. It enriches the literature on digital transformation and innovation, highlighting the importance of strategically planning the multi-sensory experience of the metaverse, especially if it is oriented toward

Key words: digital transformation; metaverse; museum; next-generation technologies; metasea; generation Z; cultural heritage.

1. Introduction

This research aims to investigate the digital transformation of museums through the implementation of next-generation technologies (NGTs), including the metaverse, which represent the frontier for revitalizing cultural heritage and reducing the gap that separates museums from their youngest potential visitors (Lee *et al.*, 2022; Choi and Kim, 2017; Buhalis and Sinarta, 2019). In particular, we explore how innovative museum concepts are taking shape to expand the target audience of young users, and how museums are shifting their activities toward edutainment.

Innovative museums are designed to allow visitors to live cultural experiences in an original way, offering them the possibility to immerse themselves in hitherto unexplored contexts, to live multi-sensory experiences, or to relive the content of the artworks with the details and atmosphere of the past (Buhalis *et al.*, 2022). A current debate (Kabadayi *et al.*, 2020; Fisk *et al.*, 2018; Barrett *et al.*, 2015) concerns the entry of museums into the metaverse. This technology has some potential that can make the museum accessible to and inclusive of different groups of visitors. It also allows for an expression of cultural heritage that is more innovative and more responsive to the needs and desires of youth. The museum is transforming from a place of conservation to a space for learning and entertainment, based on an immersion in the details of a work or in the culture that characterized an era. In other words, the metaverse is changing the concept of the museum from that of educating about culture to that of immersing in culture. We call this innovative concept the “next-generation museum”, in a more modern sense than the one introduced by Dietz *et al.* (2004). Given the recent attention paid to it by tech giants, it is necessary to understand the potential benefits and limits of the strategic application of the metaverse to museums. Although the technology and infrastructure are not yet capable of developing large-scale immersive virtual worlds, researchers are increasingly analyzing the transformative impact of the metaverse on different sectors, such as tourism, hospitality, marketing, education, and healthcare. They are also interested in the social and psychological effects of interaction in the metaverse, and in related issues of trust, privacy, disinformation, and law enforcement (Dwivedi *et al.*, 2022).

We focus on the metaverse as a mixed reality (virtual and augmented) and reconstruct its features and potential. The metaverse is a universe with several worlds (Brown, 2021; Haenlein and Kaplan, 2019; Harz *et al.*, 2022) to explore within it, through visors and Oculus VR (Teseo, 2022). It combines virtual, web, social network, and real-life components; in

the metaverse, it is possible to live increasingly immersive and engaging experiences. Some elements, such as gamification, avatars, or the extended experience, bring the metaverse closer to Generation Z (Gen Z) and make it particularly attractive to them.

We examine the role of the metaverse in supporting museums in their edutainment (education and entertainment) function. This technology allows the visitor to have an extended and immersive experience, unbounded by time and place. In the metaverse museums, virtual reality is intertwined with physical reality of the past in a sort of “back to the future” experience. The metaverse does not just transpose reality into the virtual environment. Avatars are equipped with superpowers that make the experience easier, more enjoyable, and participative. We believe that meaningful experiences with artworks and archaeological artifacts, combined with the emotional connectivity, make the metaverse journey into culture particularly intriguing and fascinating to Gen Z and strengthen their engagement.

This paper has an exploratory nature. As the metaverse applications are ongoing, very few examples are available, and those that exist are mostly in the commercial and entertainment fields. We propose to explore the opportunities and challenges of the application of the metaverse to a virtual marine museum, traditionally accessible only to experts and scuba diving lovers. First, through an interview with an entrepreneur who is also a digital designer and computer scientist, and who was among the first in Italy to develop metaverse solutions, we recognize the potential and limits of applying the metaverse to the museum. Second, to provide a more accurate and comprehensive analysis, we look at a pilot project for a next-generation museum applied to the exploration of the seabed. MetaSea™, proposed by Digital Atom at the Free Mind Foundry - Innovation Hub, offers an integrated model for monitoring and enhancing the underwater archaeological heritage in museum collections, though it has yet to be tested on a large scale. Using 5G technologies, the team involved is working on the creation of a virtual marine museum through which users can immerse themselves in archaeological artifacts of underwater origin, which are being digitized and made usable in 3D. The two cases proposed allow us to grasp the most relevant features of the metaverse journey into culture and to observe, precisely in this emerging phase, the digital transformation of museums, which are shifting toward more modern, immersive, and inclusive concepts. We integrate these cases through a field observation at the Mori Art Museum in Tokyo aimed at capturing the emotions, actions, and reactions of young people during a visit to a 3D exhibition on the world of yokai (traditional Japanese monsters, ghouls, and goblins).

Our findings provide a clearer picture of the next-generation museum. They contribute to an understanding of the meaning and value of metaverse in bringing culture closer to young people. They also show how digital transformation is leading to a next-generation museum capable of enthralling youth and allowing for dialogue between different generations.

This paper is structured as follows. Section 2 investigates how digital technology has entered museums, making the Gen Z experience more exciting and effective for edutainment, which is addressed in Section

3. Section 4 analyzes NGTs. Section 5 deals with the metaverse as an innovative tool for the valorization of cultural heritage. Section 6 outlines the research design, while Section 7 highlights the case study. Finally, Section 8 discusses the results and presents comments on the conclusions.

2. The digital transformation of museums: a framework of analysis

Traditionally, the museum is an organization serving and open to the community, with the aim of educating its audience about culture through the conservation, protection, and enhancement of cultural heritage (Brown and Mairesse, 2018). Despite its role as an attractor, the museum is often considered an elitist place, frequented by culture lovers but not very attractive to younger targets (Drotner *et al.*, 2017; Cesário and Nisi, 2022). The cultural value proposition seems distant from the interests and habits of Gen Z, which is hyper-connected, accustomed to receiving frequent stimuli from digital environments, constant use of smartphones, and communication with new languages and symbols. Museums are undergoing a growing digital transformation, which began with museum 2.0. Their goal is to make the cultural journey more engaging, attracting a wider audience of visitors. Digital transformation is often project driven, involving experimenting with digital tools and apps at the level of a single initiative. The aims are limited to improving the visitor experience, enhancing audience engagement, reducing management costs, and increasing revenues and profitability. In other cases, such transformation is a far-reaching and long-term shift, based on a strategically oriented approach, and directed at transforming the traditional museum concept into a next-generation museum (Furrer *et al.*, 2020; Huang and Rust, 2018; Baker *et al.*, 2020).

The digitization of the cultural heritage sector has been given a boost by the European funding programs (Creative Europe, InvesEU, Horizon Program) aimed at promoting culture in terms of sustainability, digitization, and inclusiveness. The Creative Europe program promotes the digital and environmental transition of European cultural, creative, and audiovisual sectors. InvestEU is an investment program to accelerate the digital transition. The Research and Innovation on Cultural Heritage initiative within the Horizon Program aims to expand the application of digital tools to preserve cultural heritage and make it widely accessible.

In Italy, various programs have been adopted to encourage the transition of the creative sectors to digital (Recovery Plan, Museum Enhancement Plan, Three-Year Plan for the Digitization and Innovation of Museums). The Recovery Plan includes several measures related to the digitization of cultural heritage, developing software and the cloud for digital data management, and offering innovative enjoyment to the public through the implementation of new technologies. The Museum Enhancement Plan adopts some measures directed at increasing the participation of Gen Z. These actions include the opening of social channels dedicated to culture; a “grand virtual tour” in collaboration with Google Arts & Culture

that allows participants to select digital routes through which to admire museums, theaters, and archaeological areas; “European Heritage Days”; “Comics in Museums”; the “#Artyouready” initiative, characterized by a web space in which to share photos taken inside museums, theaters, or other places; and a “Culture Does Not Stop” campaign emphasizing content that can be enjoyed online. The Three-Year Plan for Digitization and Innovation of Museums includes structural measures aiming to improve heritage management, display, and storytelling of works; transform the museum into a place for sharing with visitors, scholars and other museums; and incorporate innovative forms of access and use of heritage data.

Despite the various legislative and regulatory interventions, the digitization of Italian museums is still at an early stage (Fissi *et al.*, 2019; Palumbo, 2022). The major critical issues are the significant delay in the diffusion of next-generation technologies (e.g., artificial intelligence, machine learning, deep learning, Internet of Things, and non-fungible tokens) and the low turnout of young people, especially those belonging to Gen Z.

Starting from these considerations, this research investigates the opportunities and challenges of museums entering the metaverse. We intend to provide a clearer picture of the museums’ digital strategies, which aim at edutainment. We believe that central elements of next-generation museums are their accessibility and inclusiveness to visitors; higher levels of engagement of visitors, especially young people; the adoption of digital solutions, such as augmented reality, virtual reality, or gamification for a more innovative experience and storytelling; and the use of analytics tools, business intelligence, and big data systems to monitor the management of the works and enable the creation of digital museum guides. Our thesis is that a museum that is more active in the metaverse is more likely to attract Gen Z than a traditional museum. To this end, the framework of analysis we outline takes into account the following metaverse features that might be attractive to Gen Z. They are:

- A customer-centric approach: Proposing a museum concept that puts the visitor experience first can reduce the sense of exclusion perceived by young people.
- AI applications to connect and build effective relationships with visitors: Applying AI to personalize navigation in the museum can increase the sense of engagement and escapism felt by Gen Z visitors.
- Extended Museum Experience:
 - Using feeling AI technologies to build edutainment paths tailored to Gen Z visitors can improve their sense of understanding and emotional connectivity;
 - Using interactive AI technologies to start conversations about the art world and meet artists, experts, and influencers can increase user engagement;
 - Using VR and AR based technologies for artwork and storytelling can increase the sense of integration between education and entertainment;
 - Using the metaverse for museums can enhance the sensation of

escapism, allowing members of Gen Z to explore their innermost thoughts and emotions. Avatars, gamification, digital storytelling, and digital story-doing are key to arousing strong emotions and generating memorable experiences.

3. Generation Z and digital museums

Feitosa and Barbosa (2020) analyze the impact of digital museums on Gen Z satisfaction. Their results show that the degree of excitement is higher in digital museums than in traditional museums. E-won intention and perception of quality are positively correlated with the degree of excitement, and the correlation is greater for museums that adopt virtual reality. The implications of the study are significant. Given that Gen Z potentially represents a large and important segment of museum visitors, digitization based on NGTs (such as virtual and augmented reality, interactive games and mobile services) has become a central element in museums' digital transformation. Recent studies (Cesário and Nisi, 2022) show that Gen Z is an understudied group in the design of mobile museum guides and exhibitions. When asked about designing a mobile museum experience, teens aged 15-19 suggest using story-based apps and games, as they value gamification more than narratives.

Gen Z is composed of young people born between 1996 and 2010. They are hyper-connected social media users. Smartphones are the reference point for many of their activities (photo and video sharing, chat and social networks, online shopping). Being born in a digitized world influences their shopping behavior and their preference towards omni-channel purchases (Lee and Lee, 2020; Kitsios and Kamariotou, 2020; Luceri *et al.*, 2022). They look for purchasing information in online reviews, other users' opinions, and official websites. Often their attention is drawn by quick and incisive messages exchanged on social media, short videos with personalized content, talks, challenges, and collaborative activities (e.g., hackathons and live streams).

Among the various entertainment activities, visiting cultural venues, particularly museums, is not a priority. Drotner *et al.* (2017) analyze the perceptions toward museums of young people aged 13-23. The results show that a majority perceive museums as places of learning and knowledge, while for the remainder, museums are places where objects and artworks are displayed. They see museums as distant from their interests, boring, monotonous, and unengaging. The rating improves for museums that use digital tools (social media, virtual tours, games) and alternative communication channels (Manna and Palumbo, 2018). Gen Z values the sense of engagement and escapism in virtual reality, along with the opportunity for learning through a meaningful experience, the role of protagonist in an immersive reality, the emotional connection, and the usefulness of the extended experience.

Museums today are facing a twofold challenge as they attempt to increase their profitability (Heinonen and Strandvik, 2020; Kabadayi *et al.*, 2020). They are tasked with preserving the tradition-culture pair, on the

one hand, and developing the innovation-culture relationship with digital strategies and marketing policies directed at improving the engagement of Gen Z, on the other. Some studies (Ho *et al.*, 2020; Dong and Sivakumar, 2017) show that the starting point is the customer centric approach in museum management, based on social interaction and entertainment. It is generally agreed that digitization and new technologies are effective tools for promoting inclusivity and stimulating the involvement of the Gen Z. There are several examples. New York's MoMA is one of the first museums to manage social media (Facebook, Instagram, Twitter, Flickr, iTunes, Foursquare, YouTube, and Art Bubble) as interactive platforms to start discussions, create art playlists, and share digital postcards with users. Initiatives to attract younger people include the section of the website dedicated to Gen Z (MoMA Teens); the *At the Museum* project, featuring a museum web series broadcast on YouTube; and the *I went to MoMA and...* project to strengthen the bond between the museum and visitors by representing their experiences in sketches on sheets of paper that will be attached to a mural. The sketches are then used to create an online communication campaign. The Rijksmuseum in Amsterdam is another example of project-driven digital transformation. Through a platform, users can digitally download the museum's artworks, modify objects, and create gadgets for purchase.

4. Next-generation technologies for extended museum experience

Artificial intelligence applied to museum activities is becoming increasingly important, and is opening new horizons in guiding museum strategy and actions, strengthening relationships with visitors, and making their experiences unique (Bock *et al.*, 2020, Huang and Rust, 2018; Solima, 2016). Nigro *et al.* (2016) investigate the digital transformation of the 10 most visited museums in European capitals, including Amsterdam, Barcelona, Berlin, Helsinki, Lisbon, London, Paris, Rome, Stockholm, and Vienna. London has the highest number of museums with advanced technology, followed by Amsterdam, Vienna and Barcelona. The authors observe that museum digitization is not just about connecting things. Edge computing acts as a catalyst for detailed information, aggregating and transforming huge volumes of raw data into valuable and usable information. It is about converting data into insights, followers into visitors and likes into attendance. AI is currently being implemented to design fine-grained, data-driven services along the entire visitor journey. Museums are implementing AI applications to connect and build relationships with visitors by personalizing their recommendations and services, helping them navigate the museum, and answering art-related questions in real time.

This section provides a brief overview of digital technology used to revitalize museum offerings in a modern way. We focus on the role that NGTs play in addressing Gen Z expectations of cultural heritage enjoyment. Some studies (Haenlein and Kaplan, 2019; Jain *et al.*, 2021; Hermann, 2021)

show how NGTs can be used to delineate multiple paths for multiple target visitors. This can be imagined with robots that help visitors design cultural journey; digital signage that adapts to audiences; or sensors that track customer traffic patterns to inform about thematic routes (Solima, Izzo, 2018; Wirtz *et al.* 2018; Aamir, Atsan, 2020). Other research (Campbell *et al.* 2020) highlights the value of a data-driven approach in transforming the creative industry. The advantages of such an approach include reduced operating costs, increased revenues, and greater profitability. Huang and Rust (2021) develop a three-step strategic planning framework based on three levels of AI, which are mechanical, thinking, and feeling. Mechanical AI is for data collection, segmentation, and standardization; thinking AI is for market analysis, targeting, and personalization; and feeling AI is for customer understanding, positioning, and religionization. In line with the goal of this paper, we focus on meaningful experience and emotional connectivity in narrowing the gap with Gen Z, and support the proposition that a museum that is more active in the metaverse is more likely to attract Gen Z.

4.1 Interactive AI Technologies: Communication Tool with high Visitor Engagement

Conversational AI makes the communication space more fluid and provides insight into visitors' opinions, moods, and impressions of art and works. A museum can capture how visitors feel and reach out to those who want to have a relevant immersive experience. A visitor's sentiment during a cultural journey is expressed by the experiential value, which is increasingly outweighing economic and functional value (Jain *et al.*, 2021; Ruiz-Real *et al.*, 2020; Arica *et al.*, 2022).

A museum can take advantage of interactive AI technologies in several ways. On the museum side, the digital cataloging of works, room layout, activity planning, and the virtual reconstruction of destroyed objects and environments are some useful activities for the design and preservation of cultural heritage. On the visitors' side, understanding and anticipating their behavior, giving recommendations, developing a CRM, managing the experience, payment, and media optimization are some of the areas where AI is contributing positively (Barrett *et al.*, 2015; Solima *et al.*, 2016; Wirtz *et al.*, 2018). The Musée de la Grande Guerre du Pays de Meaux, for example, has exploited the potential and tools of Facebook well. This French Museum tells the story of the First World War through scenic constructions that allow visitors to immerse themselves in the battlefields and trenches. Leon Vivien, born on September 10, 1885, is a soldier who recounts-on a specially created fake Facebook account-his moods and adventures during the First World War. The project, called Facebook 1914, has been successful, obtaining about 65,000 likes, of which 50,000 were acquired in the first two weeks; followers interacted by commenting and asking questions, which the museum answered punctually. At the end of the campaign, visitor attendance at the museum increased by +45%. The Facebook 1914 project is an example of how to create engagement through storytelling to excite and stimulate interactions with the audience.

In most cases, only a fraction of the potential of interactive AI technologies is effectively exploited. Fissi *et al.* (2019), through a study of content and sentiment analysis on a sample of Italian museums registered on Facebook, show that social media communication is unidirectional, with low user engagement. Museums use social networks exclusively to communicate events, scientific and educational activities, and historical and artistic news. They focus on the use of traditional features (text, images) and have a low propensity to engage and interact with their followers and to use social media platforms in a diversified way.

Facebook, Instagram, and Twitter are the social networks most heavily used by museums. Through Twitter, and specifically through retweets of trending topics and live tweeting, it is possible to monitor several indicators about visitor sentiment and museum reputation. On Instagram, stories tell episodes from life in an informal context. The directness and immediacy with which information is transferred help create engagement and empathy. Zingone (2019) studies the types of content that some major museums, such as the Louvre and the Metropolitan Museum of Art, post on Instagram, and has identified three: spaces, works, and people. Specifically, the Instagram profile is used as a channel for disseminating information about the museum, promoting events, launching initiatives. It is a tool for contact and relations between the museum and its actual and potential visitors. Sharing, storytelling, reputation, information, and community are the keywords on which the communication activity is based. At the same time, the account supports the educational and didactic function of museums.

The social networks that are very popular among young people—YouTube, Tik Tok, Twitch, Snapchat, and Clubhouse—have great potential to increase Gen Z engagement with museums. Tik Tok is a fun and creative social network; the approach museums take there is based on ironic and surreal communication (dialogues between statues and subjects depicted in paintings that sing and dance to the rhythm of music are some examples). Twitch is a live streaming platform focused on video games; museums leverage it in offering their users virtual tours or in designing cultural games. Snapchat is a mobile app that is characterized by sending images, videos, and message that fade out after a short period. Images and photos can be enhanced with stickers, emojis and custom captions, or freehand drawings. Clubhouse is an audio chat that allows users to enter millions of rooms where they can drop into fascinating and entertaining conversations, meet old friends and make new ones, listen to music, tell jokes, or share deep thoughts. Museums can use Clubhouse to entertain guests in their favorite rooms with intriguing and unexpected conversations about the art world; exchange trivia and anecdotes on the works; meet artists; and share thoughts with opinion leaders, experts, and friends.

4.2 Augmented Reality and Artificial Intelligence for CSM

Among the NGTs affecting user experience, VR and AR are listed as the most transformative. Despite the great excitement they have generated,

these technologies have yet to show their full potential, with scholars and practitioners still in the early stages of understanding possible AI applications in edutainment. Many currently available AI models are in the developmental stage. Most of them lack the benefits of the scalability of the technology (Kaplan and Haenlein, 2019; Davenport *et al.*, 2020) and are far from being a technological standard (Longo, M.C., 2018).

Virtual reality (VR) allows museums to reproduce real environments in which the visitors, thanks to certain software, receive visual, auditory, and tactile information that allows them to simulate their physical presences in the virtual world. In recent decades, research (Kitsios and Kamariotou, 2020; De Canio *et al.*, 2022) has focused on the effectiveness of virtual reality in promoting cultural sites and destinations and attracting more visitors. In addition to being a marketing tool, VR could be an element of a museum's digital strategy, as it contributes to achieving the mission of integrating education and entertainment. There are several current areas of VR application: recreating statues, works, paintings, and historical artifacts that have been destroyed or are not available in the museum; prompting the visitor, through sensors, to interact with an object by manipulating it, rotating it, or zooming in on certain details that would otherwise be difficult to visualize; or simulating time travel by recreating scenarios of the past and allowing the visitor to walk through places of historical and cultural interest and interact with the characters of that era.

A growing number of museums have tried to experiment with the potential of VR, using visors or setting up virtual rooms. The National Museum of Finland in Helsinki offers the possibility to jump back to the year 1863 and walk inside RW Ekman's painting *The Opening of the Diet*. Similarly, the Louvre's *Mona Lisa: Beyond the Glass* project offers visitors the opportunity to interact with the painting depicting the Gioconda, acquiring visual details not perceptible to the naked eye and additional information about the techniques used to produce the work. The Museum of Oriental Art in Turin has set up a virtual room in which, through a visor and a joystick, the user is projected into the forbidden city of Beijing at the time of the Chinese imperial dynasties.

Errichiello *et al.* (2019) analyze visitors' emotional responses to virtual reality created as part of the *San Teodoro Experience*. Promoted by the San Teodoro Museum in Naples, the project included two interactions set in the Bourbon period. In the first scenario, the visitor was immersed in the virtual reconstruction of the city of Naples during the launching of a ship, accompanied by the narration of Alexandre Dumas.

In the second scenario, the visitor admired the architecture and decorations of the Pompeian domus, listened to the sound of musical instruments of that period and could compose a melody themselves. At the end of the experiment, the largest cluster of "enthusiasts," comprising mostly Gen Z visitors, showed a positive attitude towards VR technology, believing it to add value to the museum visit. "Enthusiasts" appreciated the sense of engagement and escapism, felt interest and pleasure during the experience, and were likely to use virtual reality in the future and share the experience on social networks. The other two groups ("moderates" and "skeptics"), while recognizing the VR added value to the visiting experience,

felt that VR had a low capacity to increase the sense of engagement and escapism.

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Augmented reality (AR) is one of the biggest technology trends of the moment. It allows a visitor to see the real environment with digital elements superimposed on it. Chen (2014) demonstrates the capacity of AR to revitalize and attract museum and exhibition offerings. AR can generate profound and memorable experiences, as it allows visitors to access cultural content in an innovative and original way and to enjoy a multisensory experience. A creative way to connect the art of the past with the new generations is, for example, that proposed by the Art Gallery of Ontario, in Toronto. There, after framing a work of art with a smartphone, visitors will see the subjects of the painting come to life, step out of the frame and assume 21st century behaviors, such as taking selfies. Khan *et al.* (2021) investigate the effectiveness of augmented reality applied in the Taxila museum, which is dedicated to the civilization and art of Gandhara (the artistic manifestation of Greek Buddhism) around 600 BC to 500 AD. Results highlight that museum experience is more positive when narration occurs with AR rather than through human guidance.

5. Using the Metaverse to dive into culture

The metaverse is a virtual dimension made tangible. The term “metaverse,” a combination of the words “meta” and “universe,” was first introduced in Neal Stephenson’s cyberpunk novel, *Snow Crash*, and stems from the need to transform 2D digital experience into 3D. In the metaverse, the user can connect to an increasingly deeper level of virtual reality. Damar (2021) defines the metaverse as “the layer between you and reality,” referring to a 3D virtual shared world where all activities are developed with the support of AR and AV reality.

In recent years, the metaverse has featured strongly in national and international debates on technological, political, regulatory, and economic issues. This was especially the case when, in 2021, Mark Zuckerberg, CEO of Facebook Inc., announced the transfer of this social network to the metaverse to win back younger people (Brown, 2021). There is a buzz on the parts of various stakeholders about trying to understand the potential of the metaverse in creating economic value. There is discussion of the opportunities and limitations that the metaverse presents, along with questions about the identities of avatars and the lack of international regulation for conflict resolution (Kaplan and Haenlein, 2020; Harz *et al.*, 2022). Dwivedi *et al.* (2022) propose a multidisciplinary perspective on the metaverse, highlighting emerging challenges, opportunities and research agenda for research, practice and policy.

Tourism, real estate, entertainment, healthcare, and fashion are among the business areas producing the most fertile ground in the metaverse. Compared to museums, the metaverse can be considered an innovative venue for enhancing cultural heritage in a 3D mixed reality context. Gen Z shows little attraction to passive enjoyment of artworks. During the 2019-

2021 lockdown, its members have been shown to respond positively to cultural initiatives that take place on digital communication platforms or that make use of innovative devices, such as smartphones, touch screens, tablets, QR codes, augmented reality, and virtual reality (Heinonen and Strandvik, 2020; Solima *et al.*, 2018). On the one hand, the metaverse could alter the authenticity and intrinsic value of the works, trivializing the cultural content present within the museum. On the other hand, the metaverse could improve the quality of enjoyment and communication, generating a meaningful experience more in line with Gen Z expectations. Customer experience is a multidimensional construct of what visitors think and feel about museum services (Kabadayi *et al.*; 2020). This construct has cognitive, emotional, behavioral, sensory and social dimensions. A positive customer experience has been shown to increase user satisfaction and engagement, and can be a driving force in engaging a broad swath of Gen Z as they interact with artworks.

There are four types of experiences on the cultural journey (Gilmore and Pine, 2002): *the entertainment experience*, in which the visitors passively absorb the stimuli imparted to them; the *aesthetic experience*, in which the visitors physically participate but remain passive; the *educational experience*, in which the visitors actively participate with their body or mind; and the *escapist experience*, in which the visitors are fully immersed and participate actively. The activities that are offered by most museums fall between the aesthetic and educational experience. With the metaverse, museums could set a more ambitious goal of trying to produce an escapist sensation. An immersive experience requires museums to be able to identify the experiential value desired by Gen Z and find out what young visitors feel (even when they do not know each other); determine the difference between how they think, what they think, and what they communicate; and explore their thoughts and emotions. The key elements of the metaverse that elicit strong emotions and involvement are as follows:

- *the avatar*. It is like a “digital twin” (Teseo, 2022), able to convey emotions and produce excitement. The avatar connects people to the virtual dimension and vice versa. Facial expressions (smiles, sadness, disappointment) are simultaneously transposed into virtual ones: when the user smiles, their avatar will do the same too. Similarly, virtual stimuli are transposed into real-life human senses. The voices of avatars farther away are heard at a lower pitch than those of avatars nearby. Touch sensors allow the user to feel resistance when hitting a wall or to start sweating if the user is in the virtual desert. Olfactory technology allows the digital scent of green meadows to be transferred, and the taste of food can be perceived via lickable screens. This is to create an engaging user experience (Kaplan and Haenlein, 2020).
- *gamification*. The game is one of the key elements of the metaverse for introducing effective methods of edutainment. It is based on a dynamic experience, storytelling, and active visitor participation (story-doing). Elements of the game are clues between museum exhibition halls, treasure hunts through QR codes, quizzes and tests, puzzles, and time-outs with a number of lives and limited time to visit the museum. For a game to be intriguing, it is appropriate for the game to be developed

within an engaging narrative context that can solicit emotions, open new windows to the imagination, expand the experience of life, and make the visitor take on the role of a character (Othman, 2021; Solima, 2018).

- *digital storytelling*. The digital tale consists of two elements: storytelling and story-doing. Digital storytelling is a type of storytelling that takes advantage of digital tools to create narratives. The goal is to generate a fluid and immediate narrative that can arouse emotions and a sense of belonging with unprecedented language and multimedia content of various types (video, audio, images, text, maps, infographics). Storytelling offers an experience that begins before entering the museum and continues at the end of the visit, where communication is the key element (Lambert, 2017; Vrettakis *et al.*, 2019).
- *digital story-doing*. This aims to create positive experiences through direct visitor engagement. Story-doing is a kind of evolution of storytelling, as the visitor becomes the protagonist of the story through direct participation (Buhalis *et al.*, 2022). The more the experience is able to arouse strong emotions, the greater the chance of generating a memorable experience. Neuroscience reveals that very positive experiences create what are known as somatic markers in the brain - that is, the emotions and experiences remain imprinted in the mind, and the brain will be ready to recall them to help narrow the field of possible future choices.

These factors demonstrate the importance of a metaverse journey into culture if the goal is the edutainment of Gen Z. Museums cannot limit themselves to offering an experience that involves the simple display of works of art, artifacts, or paintings accompanied by long and formal descriptions. Designing thematic tours supported by audio guides or guides is no longer sufficient. It is necessary to design a next-generation museum where the metaverse allows visitors to dive into the past (through storytelling and story-doing) but look to the future.

6. Research design

To understand the metaverse journey in the next-generation museum, we analyze a case study concerning the creation of a virtual marine museum to enhance underwater archaeological heritage. In doing so, we consider different business experiences in order to observe the metaverse from multiple perspectives: that of the founder of two digital companies with expertise in developing metaverse solutions; that of a start-up engaged in the launch of a pilot project on the virtual marine museum; and that of one of the authors, who had metaverse experiences while visiting some museums in Tokyo.

Biagio Teseo (B.T.) is the founder of two digital startups, Bdesign Italia and Reclog. He is a digital design strategist; computer scientist; social media manager; technology adviser; pioneer in 3D graphics and animation in Italy and on the Internet; and popularizer of science, innovation, and technology.

In 2012, B.T. won the Telecom Italy Award for the entrepreneurial project Reclog, the first photo-audio app for iOS and Android (no longer available today). He was CEO of Bdesign Italia, which designs and delivers digital solutions to emerging brands and companies worldwide. He is the author of a text dedicated entirely to the metaverse. Recently, B.T. was invited to participate in the first Constitutional Affairs Hearing of the Italian Senate on the topic of social networks, blockchain, and the metaverse.

Digital Atom, created in 2015 in Italy and hosted at the Free Mind Foundry Innovation Hub, provides AR/VR solutions, digital transformation services, and software solutions. It designs and develops immersive virtual experiences in multiple sectors: architecture, tourism, cultural heritage, automotive, gaming, healthcare, naval, and aviation. Digital Atom's employee team, which has specific expertise in the field of digital creation, consists of programmers, designers, and business and marketing experts. Its aim is to guide companies toward a digital transformation path and provide them with the appropriate tools, with a focus on immersive VR/AR, 3D, and 360° solutions. The company takes brands into the metaverse. Recently, it has been involved in the development of the MetaSea™ project.

Several methodological and practical considerations have led us to select this case study. From a methodological point of view, longitudinal research based on an inductive approach allows us to develop theoretical ideas about creative innovation by readily grasping the technological dynamics and the strategic processes at work, through data and interviews given by key players in digital technology. It is well suited to exploring an issue that is understudied (Yin, 2003; Eisenhardt and Graebner, 2007), but that keeps the debate on digital innovation alive. The case reveals the interaction between humans and technology in the process of strategic enterprise renewal. It also allows us to grasp the phenomenon in its essence and during its manifestation. We are aware that the case study results are not suitable for generalization. Nonetheless, we propose the case study methodology as appropriate for explaining how, why, and where a phenomenon occurs (Yin, 1994). More specifically, the selected case turns out to be critical for understanding the potential impact of the metaverse on the design of innovative museum concepts.

From a practical point of view, the selected case allows us to understand the complexity of the metaverse in its application to the edutainment field. It is a technology that has come a long way from its origin in a science fiction book from the 1980s, and is now revolutionizing business. Moreover, the case highlights the potential and limitations of the metaverse in the relationship between space and time, and between cultural enterprises and their audiences. Finally, the case highlights the contribution of creative innovation tools to serve the community. The next-generation museum presents the potential to shorten the distance that separates culture from youth audiences, mainly represented by Gen Z. Triangulation was carried out using various sources and methods of data collection, including interviews, conversations, classroom meetings during Innovation Management and Innovation Business Model classes, and other sources of background information, reporting data, or events relevant to the case analysis. Gathering data from various primary and

secondary sources improved the internal reliability of our interpretations and provided a comprehensive view of events.

Primary data included three semi-structured interviews lasting approximately 120 minutes. We interviewed the founder of Bdesign Italia and Reclog, the Digital Atom team, and the financial administrative assistant who deals with the project management and management control of the MetaSea™ project. Direct quotes presented here have been taken from interview transcripts. The focus of the interviews was the identification of the metaverse contribution to the museum. In accordance with the interview protocol, maintaining this focus during the interview increased internal validity (Yin, 2009). Table 1 includes the protocol followed and the main themes, which were understanding the metaverse concept, opportunities and challenges of metaverse, the metaverse value co-creation for the museum, the areas of innovation most affected, and the contribution of the metaverse to the Gen Z cultural journey.

Tab. 1: Interview protocol and guide

Interview protocol and guide
<p>1. <i>Metaverse application to the museum</i></p> <ul style="list-style-type: none"> - Importance of the metaverse, challenges and opportunities - Areas of innovation most affected by the metaverse - Potentialities and limitations of applying the metaverse to the museum <p>2. <i>How the metaverse creates value for museum activities</i></p> <ul style="list-style-type: none"> - Innovative channel - Tool for increasing the museum's visitor base - Tool for increasing the visitor engagement in the cultural journey - Digital strategy for achieving the edutainment goal - Managing the risk of loss of authenticity and intrinsic value of the artworks <p>3. <i>Metaverse and Gen-Z experience</i></p> <ul style="list-style-type: none"> - Contribution of the metaverse to attracting Gen Z - Places and opportunities for using the metaverse - Connectivity and interaction between the museum and Gen Z - Metaverse experience for Gen Z in five keywords

Source: our elaboration

Documentary data were obtained from press articles, specialized reports, press releases, and web hearings that dealt with the subject matter. We integrated the interviews with field observations collected by one of the authors during her stay in Tokyo. The observations refer to the behavior of the young visitors during the Hyakkiyato Exhibition of Mizuki Shigeru at Tokyo City View, Mori Art Museum, on August 11, 2022. The observations, which lasted two and a half hours, took into account the time spent by the visitors in the museum; how the learning experience was designed; reactions to artwork before, during, and after using 3D technology; path among the artworks in search of the QR codes associated with them; participation and interaction with the works and with other visitors; impact on learning and enjoyment; and overall evaluation of the experience.

7. The Case Study

7.1 *The digital transformation of Italian Museums*

Italy is internationally recognized as having a central role and excellence in cultural heritage, as characterized by a large number of Italian artistic works from prehistory to the present. Italy is the first country in Europe in terms of the number of museums, which are spread throughout the country. The situation changes in terms of the number of visitors per museum from 2019 to 2021 (Statista, 2023). Italy has dropped in the ranking of the most visited museums worldwide, placing 17th with the Uffizi in Florence (with approximately 862,000 visitors in 2021 compared to 2.1 millions in 2019), while the Louvre Museum in Paris (2.83 millions), the Shanghai Science and technology (2.38 millions), Metropolitan Museum of Art in New York (1.96 millions), Vatican Museums (1.61 millions), the National History Gallery (1.56 millions) and the British Museum (1.33 millions) in London are at the top. About forty-six percent of Italian museums are in northern regions, 27% in central Italy, and the remaining 27% in the south (ISTAT, 2022). These include smaller museums located in small towns. Archaeological museums are among the most numerous, followed by museums of ancient, modern, and contemporary art; museums with anthropological collections; and museums with a religious character. Eco-museums are present in limited numbers. To make efficiency gains, most public Italian museums are organized in networks so as to share technologies and human and financial resources. Cellini *et al.* (2020) documented the spatial dependence effects in the case of services provided by Italian museums.

From 2007 to 2019, there was an increase in paid visitors, especially corresponding to museums' entry into digital platforms and a website redesign (Agostino *et al.*, 2020). However, the percentage of youth group visits was low, especially when compared with other recreational activities (cinema, sports shows, clubbing). Among the various platforms, Facebook was the one with the highest engagement, followed by Instagram and Twitter, with growth in the number of published contents, reviews, and posts. The growth trend stopped in 2019 due to COVID-19. In response to the dramatic decline in visitors and revenue, museums have responded with more dynamic and creative offerings made through digital platforms (online exhibitions, virtual tours, in-depth videos, social media). TikTok was used by the Uffizi art museum in Florence, for example, to represent art and culture in an ironic way; the protagonists of the paintings were animated and transformed into funny memes, singers, and dancers of current hits. The Uffizi revisited social media in an innovative way, defining a new channel to attract young audiences who were different from those who usually visit the museum.

In general, the post-COVID situation has triggered a transition of museums to digital through projects directed at using social media and platforms as innovative channels in which to interact and engage with the public, as well as means of communication. Data from the Digital

Tourism Observatory (www.osservatori.net) show an increase in museum followers on Instagram (+7.2%), Facebook (+5.1%), Twitter (+2.8%). The Milan Polytechnic has designed a monitoring platform called Museum Reputation, with which it is possible to visualize the intensity of digital interactions between museums and users. Based on data collected on Facebook, Twitter, Instagram, TripAdvisor and Google Maps, 4 indicators were constructed for the platform: followers on social channels; interactions with posts published on social media; reviews on TripAdvisor, and trending hastags.

The observed data show that digital strategies promote an increase in traffic generated and a growth in museum reputation through a more intensive and extensive use of digital tools and apps for single project. For Italian museums, key critical issues related to a project driven approach include the accessibility for visitors with disabilities; digital cataloging of works; online services (ticketing, free wi-fi, digital maps, geolocation); more immersive experiences through smartphones, touch screens, QR code tablets, virtual reality and augmented reality; and human resources and professional figures with digital skills and the ability to cultivate online cultural communities. Although the current trend is toward a digital transformation based on a project-driven approach, early examples of metaverse museums, designed with a long-term strategic oriented approach, have also appeared on the scene. These are pilot projects launched on an experimental basis in the field of the cultural heritage, which lend themselves to becoming models to be replicated on a large scale.

7.2 *The Metaverse Journey into Culture*

Starting from the interviews, whose content is summarized below, we reconstructed a clear picture of the next-generation museum, allowing us to grasp the most relevant features of the metaverse journey into culture.

Understanding the Metaverse. The metaverse is a rapidly evolving technology that can be an innovative channel for generating business opportunities. In a metaphorical sense, the Metaverse is a universe with many worlds in it that one will be able to interact with; it is explorable from smartphones and PCs through glasses and Oculus VR. According to B.T.:

The metaverse is natural chaos. It represents the new Wild West of technology, after the creation of the PC (personal computer), the arrival of Internet, iPhone and social networks. Is the metaverse a machine? A piece of hardware? Is it just a computer program, an App, a software? Is it a virtual world to enter and begin exploration? Yes and no, these are all legitimate questions.

Founder, Bdesign Italia and Reclog

Technically, the metaverse is a virtual space that also affects the physical (real) space. This technology, called mixed reality, allows one to see the physical space inside the digital world.

The metaverse is a shared space-time structure within which it is possible to carry out various activities (play games, attend concerts or conferences, travel, meet other users and even conclude commercial deals). All this thanks to the “network portability” of environments in real time. The metaverse lies between ubiquitous computing & cloud computing. It is a cyberspace given by the combination of video, virtual reality and augmented reality. The access is via 3D viewers and one’s own avatar.

CEO, Free Mind Foundry

VR is one of the main technologies for creating the virtual worlds that constitute the metaverse, allowing for an immersive experience with the characteristics of the presence effect. AR mixes physical reality, the real world, with virtual, fake, computer-built objects. Through AR, the user can interact with virtual objects and other connected users, experiencing the sensation of touch, space, altitude, and soon the sensations of taste and smell. In this regard, B.T. believes:

If the Internet represented WEB 1.0 and connected people with information, social networks represented WEB 2.0 and made the WEB 1.0 content social by connecting people with each other. the metaverse is or will be WEB 3.0., which will connect people, “objects,” WEB 1.0 and 2.0 worlds, and physical and digital reality.

Founder, Bdesign Italia and Reclog

The avatar is the basis of virtual reality. It is appropriate to have only one avatar with which to wander between worlds. On this note, B.T. specified:

The Avatar is a digital copy of oneself, a digital twin, that immerses the user in worlds that exist only within the machines and makes us appear different from the way we are. The new frontier is to be able to gather in virtual environments and interact with other participants through one’s 3D avatar-that is, a digital representation of the body. The regulation of the avatar at the international level is crucial. Aspects to take into account are: personality, how to choose the avatar, safety when interacting with other avatars, but also safety in managing data privacy and analyzing behavior.

Founder, Bdesign Italia and Reclog

Metaverse application to the museum. The metaverse is a new shockwave that will call everything into question. Tourism, real estate, e-health, and entertainment are among the first to experience it. However, it will take a few more years for it to become widespread; VR and AR technologies are almost mature, but the infrastructure and technology of visors is not yet. Positive and purposeful use can be made of its applications. There is a need to build experiences as well as digital objects. In this regard, the interviewees state:

Among those interested are entire States. One example is Downtown Santa Monica District, which officially became the first major city in the United States to “enter” the Metaverse. Consider the tourism and real estate sectors, which have proven very fragile with the pandemic. Even now they are working in the metaverse direction, organizing virtual tours to real places, as digital twins, or again, fantasy, thematic

places, imagine Space, the Old West. Here's also potential in events within theaters, museums, concerts, where the audience doesn't have to be spectators but can also become actors.

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Considering modern technological devices and their interactive nature (game consoles, smartphones, tablets, virtual and augmented reality devices); the availability of digital/digitized content on the Web; and the growing availability of web connectivity, the future challenge of the metaverse concerns the enhancement of cultural heritage in terms of audience development. This challenge can also be tackled using playful video products (augmented reality, multidisciplinary displays, digital storytelling, social gaming, digital contests, emotional tourism), thanks to which it is possible to experience unprecedented prospects for the valorization of resources, including the economic one.

CEO, Digital Atom

The edutainment function of the museum. In the educational approach, information is conveyed from the museum to the user. This is a one-way journey, which starts from the museum's description and consists of the storyline of a work, an interview with an expert or a tour with an operator. The entertainment approach involves asynchronous interaction, starting with visitors, who have the goals of having fun, relaxing, and socializing. The metaverse approach consists of a two-way journey, from the museum to the metaverse and vice versa. It is synchronous and simultaneous interaction, in which museum and visitor interact in real time. It stimulates dialogue and interaction at a distance in real time. To this end, B.T. specified:

Do you know those movies where a cartoon character interacts with a live actor? For example, Roger Rabbit, or even more dated, Walt Disney's Alice in Wonderland. All it takes to do this is the smartphone, pointed at a work of art, which will show data on who made it, a behind-the-scenes movie or project us into the relevant era. There are also apps that show the names of stars and planets in real time simply by pointing the smartphone at the sky. Imagine the excitement of children, right? And think now how simple and engaging studying like this would be. You could take learning to a more intriguing, fast, and advanced level.

Founder, Bdesign Italia and Reclog

In the case of museums, we propose an approach to the visit such that each element of content can find its own narrative space and offer the visitor that experiential moment capable of translating into vivid learning opportunities. Through new perspectives of engagement and edutainment, storytelling, promotion and development (including commercial), the museum communication will be able to make cultural heritage a narrative vector, with enormous educational scope and potential tourism spin-offs. New accessibility models and new visitor flow management dynamics will be able to make the moment of the visit an active element that will not only tell the story of the places, works, artifacts, but will involve visitors in real "co-creative tourist experiences".

CEO, Digital Atom

How the metaverse creates new museum concepts. The MetaSea™ project is a pilot project Digital Atom developed together with the Ministry of Economic Development, the Naval League, and the University of Catania for the construction of the most immersive and engaging virtual museum of underwater archaeology and marine organisms.

MetaSea™ intends to test on a regional and national scale an integrated model for monitoring and enhancing the underwater archaeological heritage in museum collections. Through the audiovisual context, the fabric of marine museums takes on a new dimension within the intangible cultural heritage. It becomes a marine museum, as a permanent structure, capable of attracting visitors and which acquires, catalogues, conserves, sorts, and exhibits cultural heritage for educational and study purposes.

CEO, Digital Atom

Digital strategy and tools for achieving the edutainment goal. On the supply side, the metaverse is an innovative venue where profits can be realized. In addition, MR environments, collected data, and gamified activities are digital, non-invasive tools that can be used to quantify and characterize visitor experience or enhance space exploration.

The MetaSea™ project consists of the reproduction of a virtual marine museum containing interactions and information on the marine ecosystem. The archaeological artifacts of underwater provenance are digitized and made usable in 3D. MetaSea™ uses highly technological and sophisticated tools and equipment, such as visors that allow the enjoyment of immersive content in virtual reality, as well as innovative computing devices for the creation of this type of content, such as modeling software, rendering, waterproof cameras, and video cameras with a maximum resolution, capable of capturing incredible 360° images. This enables users to view a wide range of broadcasted, high-quality content and have a unique experience, virtually immersing themselves within a marine ecosystem that frames this project.

Digital Atom Team

In addition, designing the worlds and creating the objects of the metaverse requires cross-functional professionals who work in and with digital. These include designers, computer scientists, programmers, engineers, and graphic designers; experts in music, arts, film, and performing arts; video makers; and experts in animation, psychology, and philosophy.

The audiovisual services and contents are created using virtual reality and immersive functions, network architectures for remote management and interactivity; professional audio and video recording systems for the acquisition of sounds and images; and the production of content in 8K audio and video format, which, thanks to 5G, can also be used on the move with stand-alone devices (including smartphones and viewers stand-alone virtual reality). The creation of content for virtual experiences of aquatic and underwater archaeological species requires the involvement of 5G experts applied to the audiovisual sector, scholars and researchers

passionate about individual sites, museums, and artefacts on the conservation and protection of marine heritage.

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Opportunities and challenges of the metaverse. The application of the metaverse to the museum can also generate opportunities and digital transformation in other sectors or fields of activity connected to the museum. The digital initiative can become a model of economic development for the partners who will take part in it. The stakeholders interested in the development of a metaverse museum include subject matter experts (SMEs), high-tech companies, spin-offs and startups for the promotion and dissemination of their results in the digital context; students, researchers, and young professionals, who use the metaverse for research and the acquisition of scientific and technological knowledge in specific fields; and the communities of people attracted by marine space activities and by the opportunity of the social inclusiveness. In this case, the Digital Atom team specified:

The project aims at user enjoyment of underwater archaeological areas and museums that preserve artifacts of underwater origin, with specific reference to the discovery of marine organisms and their biodiversity. All this in close connection with the study of their evolution and the dynamics of marine ecosystems, through an integrated and interdisciplinary approach. In the area of biology, MetaSea™ supports research institutes and universities in the scientific exploration of marine flora and fauna. This will take the form of a thorough study of marine ecosystems for marine biology centers with an analysis of the ecosystem, its dynamics, and its evolution. Biodiversity monitoring will prove to be a tool for research centers to monitor the health of the seafloor. In the field of archaeology, MetaSea™ will enable the enjoyment of underwater archaeological areas, ensuring the monitoring, protection, and preservation of marine archaeological sites.

Digital Atom Team

One of the challenges of the metaverse is to contribute to the achievement of museums' sustainability objectives, reducing their environmental impact and promoting social cohesion and inclusiveness.

It is a project of innovative entrepreneurship and social innovation as engines for territorial regeneration. 3D reconstruction using virtual reality and photogrammetry of a marine environment will enable users to be able to explore and learn about the biological life found on the seafloor. There will be a system of 5G technology applied to the audiovisual sector for the enjoyment of marine content, where the focus will be on the concept of environmental, social and economic sustainability for the welfare of the community, marrying the concept of positive externalities to raise user awareness of respect for the seabed. In the context of tourism, it can support the development of the underwater archaeological tourism, to mean the underwater archaeological routes with very low environmental impact. The tourist enhancement of underwater heritage will be understood as a tool for exploring the marine environment interactively, thus creating an "immaterial" museum accessible to all, popularizing a new concept of the

The metaverse and the Gen Z experience. Underexplored fields, such as gamification or the use of mixed reality (virtual reality and augmented reality) environments, bring the metaverse closer to Gen Z and make it particularly attractive. Gamification also offers the opportunity for partial control of interactions and makes the journey into culture particularly intriguing. In relation to their experience, the interviewees state:

We experimented with the immersive technologies at museums to see if they could add value compared to a traditional visiting experience. Of all the immersive technologies, metaverse is probably the most promising one especially in bringing Generation Z closer. Metaverse can help museums enhance the experience and bridge the gap that exists between digital natives and museum art and works. Augmented reality, a sub-type of mixed reality, is attributed the ability to simultaneously represent both the real and virtual world without eliminating the user from reality, thus providing a better level of interactivity in a three-dimensional space.

Founder, Bdesign Italia e Reclog

The project target schools and educational institutions. In addition to contributing in the educational, recreational and cultural terms, it leverages the social and inclusion aspects. Specifically, in the educational sphere, it makes the teaching of biology more attractive, through a VR marine documentary which enriches the experience with immersive tools. It also intends to create an educational game for children to explore marine biodiversity and interact with it while wearing visors.

Digital Atom Team

Digital Atom aims at the long-term and large-scale replicability and sustainability of the MetaSea™, with the aim of educating Generation Z to respect the sea and biodiversity, sensitize young people to protect and enhance cultural heritage and promote social cohesion and inclusiveness.

Digital Atom Team

Measuring the visitors' metaverse experience. The museum experience scale (MES) and the multimedia guide scale (MGS) are useful measures (Othman *et al.*, 2013) for assessing the metaverse museum experience. The MES consists of four factors, which are Engagement, Knowledge/Learning, Meaningful Experience and Emotional Connection; the MGS includes three factors, which are General Usability, Learnability and Control, Quality of Interaction.

In a metaverse journey into culture, engagement, that is the interaction between visitors and museum content, is triggered when levels of attention and commitment are high. This typically occurs when the content is resonant, information-rich, and interactive. Learning and knowledge, represented by the amount of knowledge

gained after the museum visit, are facilitated by the way information is presented and delivered. Meaningful experience, understood as an impactful experience that is not limited to information, is achieved through interactions with the art and works and comparison with other avatars. Accessibility and inclusiveness are fostered by general usability, appropriateness to context, ease and comprehensibility of cultural content animated by technology, quality of interactions between digital objects and user action. Finally, emotional connection, understood as the ability to generate and spread positive emotions (joy, wonder, excitement, discovery), is achieved through simulation.

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MetaSea™ will make the underwater heritage accessible, allowing to discover and rediscover underwater archaeological sites with the help of virtual reality and to communicate underwater. The implementation of the 5G network will be applied to underwater marine museums and will favor the use of places with greater safety for operators and visitors, especially the younger ones.

The development of audiovisual tools in the sphere of environmental heritage can contribute to the popularization of science and thus to the awareness of a wider audience of people, especially the young and the differently abled, on issues of great interest. From this perspective, the MetaSea™ project can lead to progress in knowledge related to effective models of aesthetic and cognitive learning of users.

Digital Atom Team

Figure 1 shows the diving and filming for MetaSea™ in the seabed in front of Capo Mulini, officially started in October 2022. The team first performed the setup activities of the “suex synapse system” for mapping the Timpa Wreck site. Subsequently, the team conducted the first dives and filmed in the seabed for site documentation to plan the image acquisition, in agreement with the scientific team.

Fig. 1: First dives and filming in the seabed for MetaSea™



The field observations refer to the behavior of the young visitors during the Hyakkiyato Exhibition of Mizuki Shigeru at Mori Art Museum, Tokyo. The exhibition, set up to commemorate the 100th anniversary of Mizuki Shigeru's birth, was on the world of yokai (traditional Japanese monsters, ghouls, and goblins). It reveals how the Japanese ghouls, depicted by the artist, came to be. Through the use of apps and labels placed in hidden corners of the rooms or behind the works, visitors could easily immerse themselves in the artist's works through 3D technologies (Figure 2). The observations revealed the following:

- the time spent by visitors in the museum increased, reaching about 90 minutes compared to the planned 30 minutes;
- the learning experience was designed in such a way as to allow visitors to come into direct contact with the yokai protagonists in the depictions;
- without the 3D technology, young visitors were passive and slightly distracted. With 3D representation, the Gen Zers were surprised, smiling, intrigued, and enthusiastic. They interacted with other visitors, exchanged information, and reviewed the same representation several times, walking the route repeatedly;
- the search for the QR codes associated with the depictions allowed a non-linear path, to discover little-explored corners of the museum room, behind the works, on the carpets and on the windows, in relation to the type of monster depicted;
- participation and interaction with the works and with other visitors were very high;
- the impact on learning and enjoyment was high. The 3D depictions allowed the Gen Zers to fully enjoy Mizuki's world of yokai, to easily identify the artist's main subjects, and to immerse themselves in the context from which the depictions were created;
- at the end of the visit, the young visitors were very amused and satisfied, above all for acquiring a greater familiarity with yokai and a greater understanding of how the artist had portrayed the macabre figures by rooting the yokai culture in the world of modern Japan.

Fig. 2: 3D images at the Hyakkiyako Exhibition of Mizuki Shigeru, Tokyo, 2022



8. Discussion and conclusions

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This study highlights the strong impetus the metaverse provides for the renewal of museum. Firstly, it provides suggestions for and insights into the application of the metaverse as part of museums' digital strategies. The research allows us to identify the potential and challenges of this technology and to understand how a strategically oriented digital approach guides museums toward the goal of edutainment. The research enriches the literature on digital transformation and innovation (Lee *et al.*, 2022; Buhalis *et al.*, 2022; Furrer *et al.*, 2020), highlighting the importance of strategically planning the multi-sensory experience of the metaverse, especially if it is oriented toward the edutainment of young people. Secondly, the qualitative analysis contributes to understanding the intensity of lived experience in the metaverse (Feitosa and Barbosa, 2020). Visitors can fully experience artworks and archaeological artifacts, living an escapist sensation and strong emotions. The process of value co-creation is transformed; involvement and participation are necessary, but not sufficient to live the multisensory experience.

Thirdly, our findings underline the contribution of the metaverse to enriching the experience of young people. It brings Gen Z closer to learning about cultural heritage thanks to the possibility of living unprecedented experiences in an engaging and inclusive way (Lee and Lee, 2020; Kitsios and Kamariotou, 2020; Fisk *et al.*, 2018). As discussed, Gen Z is composed of digital natives, hyper-connected young people, most of whom spend their free time surfing the web from mobile devices. The digital footprint that distinguishes this generation requires museums to revise their strategic approach, currently based on formal communication and a static and standardized service, and to offer dynamic, original, and engaging proposals instead. The analysis shows that the metaverse can become an effective tool, even if it raises some concerns about the social and psychological effects it can cause.

Finally, Italian museums are struggling to take off in the field of technologies that enable immersive experiences. The paper covered examples of pilot projects aimed at creating innovative virtual museums in the seabed. Their implementation opens the door to numerous opportunities for innovative value propositions for museums (Baker *et al.*, 2020; Bock *et al.*, 2020). The next-generation museum has two tasks: keeping the imprint of history and tradition and rereading it in a modern key. The pilot project highlights the possibility of increasing Gen Z engagement by leveraging the customer-centric approach. Feeling AI technologies will allow museums to build edutainment paths tailored for Gen Z that can help them develop greater understanding and emotional connectivity. The metaverse enables enhancements of MES and MGS dimensions such as engagement, knowledge, learning, meaningful experience, usability, learnability, and interaction (Othman *et al.*, 2013). It stimulates curiosity and interest, motivates visitors to learn more about the works, and improves the usefulness and usability of the structure. Visitors spend more time in the museum and experience the works. Avatars, digital storytelling, and story-doing are effective tools for making young people

passionate about culture, improving their learning and, most importantly, immersing them in the events that distinguish history and make cultural heritage invaluable.

These results provide guidelines and food for thought for practitioners interested in creating innovative concepts for next-generation museums. Although scholars and experts have been talking about the metaverse for several years, the technologies and infrastructures are still in their early stages. This research observes the ongoing phenomenon. Thus, although the present paper considers Gen-Z, it does not include empirical data on this target audience, but reports indirect results related to the design of innovative entrepreneurial initiatives on the metaverse, with Gen Z as the main target. In addition to suffering from a lack of data, the study is limited in its generalizability. Future research can repeat the exploratory process by investigating more case studies and adopting qualitative software to statistically investigate the insights that emerged from the interviews. Another line of research concerns the study of visitors' behaviors; how they perceive (or not) information through their avatars; and how they react to the stimuli before, during, and after the cultural journey.

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Academic or professional positions and contacts

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