Museums x Technology:

Innovating the visitor experience through extended reality technologies

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Master's Thesis
June 2022

What's next for museums?

ABSTRACT

Do you remember the last time you've been to a museum and you enjoyed it? First and foremost, in a fiercely competitive leisure economy, museums are faced with the challenge of gaining a strategic position as an option for spending leisure time, therefore being able to provide memorable and unique experiences. Breaking down existing barriers and challenging the traditional role of the museum as a collection-focused institution preoccupied mainly with preservation and spectatorship, new forms of technology represent a tremendous possibility for museums to offer unique experiences to their visitors. In particular, technological breakthroughs such as extended reality (XR), if suitably implemented, represent a sizable strategic opportunity for differentiation. Given the increasing interest in the possibilities that emerging technologies present in the realm of cultural tourism, academic inquiry is necessary to fill up existing gaps in knowledge. By conducting a qualitative study based on existing literature and the thematic analysis of 19 semi-structured expert interviews using a deductive, theory-driven approach, the present study tries to answer the question of how museums use XR technologies to innovate their visitors' experience in order to gain a strategic position. The findings reveal that extended reality technologies can support an experience-based innovative visitor model that accounts for strategic differentiation, bridging the real and the virtual worlds in a synergistic manner and having the potential to engage the visitor, stimulate participation, and let the visitor co-create the experience.

Evidence is found that at the core of the experience design should be the visitor and that the technology integration should represent a form to support the visitor orientation.

Keywords: museums, technological innovation, extended reality, visitor experience, expert interviews/strategy/strategic differentiation

ACKNOWLEDGEMENTS

Growing up, I would see myself on some winter days gazing at a painting with endless summer skies and green fields, wondering: *what if I could jump inside and run around?* For me, museums- as places of experimentation- can answer that captivating question of "what if?" and break the boundaries of space and time, heading to somewhere imagination has no limits. In the famous words attributed to Piccasso, "everything you can imagine is real". My belief is that emerging technologies, especially extended reality through its function of blurring the boundaries between real and virtual, can provide a new form of experience. This has been the main driver behind my choice to start this study.

Undisputedly, there is no absolute nor definite result when embarking on a research journey about a topic so intricate and multifaceted as this one. There are no perfect answers nor all-size-fits all solutions, which may come off as a frustrating truth at times. But I hold out hope that this study will bring its readers a step closer to understanding what's in store for museums and what opportunities lie in the field of emerging technologies such as extended reality. I would like to express my tremendous thanks to the nineteen experts who participated in this study, sharing their valuable insights and opinions, most of them having a lifetime of consolidated experience behind them. Our conversations deepened my understanding on many levels, inspired me to look for creative answers, and provoked critical thinking. Then, a big thanks goes to my coordinator, Mr. Matthijs Leendertse, who showed great faith in my topic and supported me unceasingly throughout the past months. I was truly lucky to be able to choose a topic of personal interest and receive trust, guidance, and support. Last but not least, I would like to thank my grandma, whose painting showing those green endless fields and a blue summer sky inspired me, some twenty years after, to start this study and reflect on those "what ifs". This paper would have not seen light without you all.

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1. INTRODUCTION

What if? What if you could step into a painting? What if you could travel back in time to discover places that no longer exist or talk to historically significant personalities? What if you could fly and explore the cosmos, seeing planet Earth from above? These *what ifs* are an endless source of fascination and intrigue. Imagine you could extend reality and make these scenarios come to life. Museums, as a playground and space for creativity (Borja-Villel et al., 2014) and a site of experimentation (Macdonald and Basu, 2007; Passebois-Ducros, 2019), have the potential to not just tell their visitors what if but actually let them experience these scenarios, challenging notions of space and time beyond the museum walls. Tracing back the etymological origin of "museums" to the Ancient Hellenic language, the Mouseion (*Μουσεῖον*) at Alexandria designated a place dedicated to the Muses, where art and science intersected, offering a space for interdisciplinary research and networking (Bast et al., 2017). This unique intersection between art and science defines the museum as a space, an institution, and an experience, positioning the museum sector at the forefront of innovation in a rapidly evolving world. In order to become future-proof, museums need to capitalize on this unique intersection and redefine themselves by embracing a vision that guarantees their survival and relevance in the context of dynamic developments of technology, art, media, and society. One way to stimulate this process of renewal is by looking into strategies for innovating the visitor experience. No longer institutions dedicated mainly to collection, preservation, and spectatorship, museums have to find new possibilities to connect to their audiences. In the contemporary experience economy, the role played by non-tangible, immaterial experiences has become pivotal (Pine and Gilmore, 1998; 1999). Museums have started to address this change of paradigm in visitor behavior and have been thinking of new ways to reinvent themselves (Anderson, 2012). Can emerging technologies provide help in this respect? Technological innovation has been regarded as a facilitator in new museum-visitor relationships and a key opportunity for innovating the visitor experience (Camarero and Garrido, 2012; Pallud and Monod, 2010; Trunfio et al., 2022). Emerging technologies such as XR are considered to be a radical possibility for creating unique experiences. However, the experiential turn and the adoption of technology in museum practices have not come without contestation. To the contrary, they created a source of concern, revolving around issues such as authenticity, credibility, and value. This belongs to debates arising both in

academia and amongst museum practitioners about the“Disneyfication” of culture and the trivialisation of the museum experience, cautioning against a misalignment with the core values and purpose that museums are founded on (Kotler & Kotler, 2000). Understandably, these concerns arise in a context where there is not yet a sense of perfect clarity on how XR technologies can be properly implemented, with several museums preferring to showcase their exhibits in conventional manner (Camarero et al., 2015). Nevertheless, taking into consideration the abrupt technological advances, as well as the fast-paced changes in visitor behavior, it becomes self-evident that museums cannot remain dedicated to traditional forms of content delivery and should consider ways to renew the way they design the visitor experience (source). This constitutes an opportunity to gain strategic advantage in a highly competing leisure economy where time is the currency of value (Pine and Gilmore, 1998) and where there are more options of spending leisure time than ever before due to “shifts in both quantity and quality of leisure expectations” (Falk, 2009, p. 42).

The goal behind his study is to capture a multifaceted topic and provide perspectives about state-of-the-art practices in the museum sector with both societal and scientific relevance. These can contribute to an expanding corpus of literature, as well as inform museum practice when it comes to gaining strategic advantage by innovating the visitor experiences through the use of emerging technology, specifically XR. Drawing upon these premises, the following research question is proposed:

RQ: How do museums use XR technologies to innovate their visitors’ experience in order to gain a strategic position?

In order to guide the analysis process, several sub-questions are proposed, converging towards the main research question underpinning this study. First and foremost, as innovation constitutes a main theme in the discussion about museums and technology, it becomes natural to investigate how it is understood in the museum context and how it relates to museum strategy. With this consideration in mind, a first sub-question is introduced below:

SQ1: How do museums use innovation in visitor experience to gain a strategic position? -> differentiation in experience through technological innovation in visitor experience

As it is acknowledged that museology has shifted from being collection-focused to visitor-centered (Bast et al., 2017; Falk, 2009; Simon, 2010), it is clear that the visitor should occupy a central position in the world of museums and designing the museum exhibition is inseparable from considering the key role played by the audience. In this sense, XR technologies can be integrated in models that support the visitor orientation of the museum, relying on three components: visitor engagement, visitor participation, and experience co-creation. Drawing upon this, a set of sub-questions is proposed for exploring the topic further:

SQ2: How do museums use XR technologies to engage the visitor?

SQ3: How do museums use XR technologies to stimulate visitor participation?

SQ4: How do museums use XR technologies to co-create experiences together with the visitor?

To answer these questions, the present paper has taken a qualitative approach. The existing literature represented a point of departure, from which major themes were identified. These themes were explored throughout interviews with nineteen experts who possess the necessary background and experience. This paper is organized as follows. The remainder of this chapter embeds the study in scientific debate, addressing existing gaps in research, and explains its societal relevance. The Theoretical Framework chapter discusses the main themes related to innovation, extended reality, and visitor experience, providing a conceptual framework towards the end that will serve as an a priori guide in the analysis. Next, the Methodology chapter presents and justifies the research design, outlining the data collection and data analysis approaches, as well as reflecting on reliability, validity, and research ethics. Following that, the Results chapter presents the findings of the study. Lastly, key findings, theoretical and societal implications, several limitations of the study, and directions for future research are all included in the Conclusion and Discussion chapter.

1.1. Scientific relevance

Since the late 20th century, paradigmatic shifts in museology have advanced a new agenda for theoretical discussions around museums (Falk and Dierking, 1992; Hooper-Greeenhill, 1994; Vergo, 1989; Weil, 1990). An increasing amount of academic literature has discussed that it is necessary to view the museum as being driven by innovation (Bakhshi and Throsby, 2009; Decker, 2015; Eid, 2019; Falk and Sheppard, 2006; Navarrete, 2019; Vicente et al., 2012). This demonstrates the increased interest in studying museums in relation to innovation. This may be relevant for providing conclusions that can be transferred to other segments of the cultural and creative industries, as these are faced with a crucial need to innovate (Coblence and Sabatier, 2014). This research paper aims to contribute to the expanding literature on innovation and strategy in the museum sector, by investigating the ways in which emerging technologies such as XR can be implemented for innovating the museum visitor experience. Several scholars draw attention to the need to perform research in this direction in order to fill up existing gaps in academic debate (Jung et al., 2016; Trunfio et al., 2022). While there is expanding literature that explores museum visitor experience and various frameworks and models to evaluate it have been introduced, the extent to which they address the role of emerging technologies has remained limited. As recent studies such as Komianos (2022) argue, an increasing number of XR applications have been implemented in museums, yet academic inquiry into how to implement XR in museums remains scarce, with a limited number of systematic reviews on the topic. Contrastingly, there is a wide corpus of literature that discusses XR applications in other creative industries which confirms the scientific relevance of XR as a technology with numerous applications and potential for further development (Novakova, H. and Tarchoň, 2021).

The present study addresses these existing gaps and provides a set of findings that can be relevant for future theoretical discussions. For this, it questions traditional disciplinary boundaries and it explores the influence of technology in the museum context.

1.2. Societal relevance

Asked about the main challenge that she faces as museum president, Laurence des Cars- then director of Musée d'Orsay, currently director of the Louvre Museum since 2021- gave a

response that brought to the fore the quintessential goal that museums have- creating a meaningful connection with the visitor:

> "If you don't have this, you don't have a museum. You should never lose sight of this main objective. Sometimes people say – *What is fantastic is an empty museum when it is closed. You have your museum all to yourself. As a director, it must be fantastic to work alone in your galleries.* I hate an empty museum (...) I really do not have a passion for museums empty of visitors" (des Cars, 2017).

This remark, coming from the current director of the most visited museum in the world, encapsulates a perspective that has been crystalizing since the second half of the 20th century, according to which the visitor- not the collection- is the central element in the world of the museum. The paradigmatic shift from object-oriented to audience-focused museology is well documented in the literature and acknowledged unanimously by scholars. Besides its scientific importance, its relevance for the broader discussions in the public space is key. The present paper has tremendous societal relevance for it relates to techniques founded on new forms of technologies and relationships between museums and visitors, providing clarity regarding a topic that has been intensely brought up in a vast number of high-profile conferences, webinars, and non-academic publications across the globe. Connecting back to the Louvre Museum referred to above, it is worthwhile to mention that the institution has been experimenting with solutions to mold the tension between past and present into an opportunity. In this sense, it has been reimagining its most famous artwork by experimenting with VR technology, letting its visitor experience "Mona Lisa Beyond the Glass" as part of a 2019 initiative to commemorate the 500th anniversary of Leonardo da Vinci's death (Louvre, 2019). Certainly, many would argue that not all museums are the Louvre, benefitting from far less popularity and resources. Nevertheless, this paper wants to provide answers that would interest museums regardless of their size and type, demonstrating the possibilities brought around by XR. Well interpreted, the findings of this paper can serve industry professionals and practitioners to elaborate strategies for innovating the museum visitor experience, providing a theoretical foundation supported by evidence gathered from experts with a well-rounded understanding of the topic. These pragmatic implications align

to the broader purpose behind this study, that is to address and, if possible, provide answers to a problematic yet fundamental question in today's society: *"What's next for museums?"*

2. THEORETICAL FRAMEWORK

Drawing on theoretical insights from leisure, cultural tourism, consumer psychology, innovation and management, visitor research, and museum studies, this chapter aims to introduce, connect, and briefly explain the most relevant concepts underpinning this study. In doing so, it aims to develop a theoretical foundation that will guide the analysis process. After examining the literature, several concepts have been used as main themes for this study, each having several corresponding sub-themes. While several overlaps may appear in the literature between the concepts presented next, this study is using pragmatic working definitions that facilitate a structured conceptualization. Lastly in this chapter, a conceptual framework will be introduced.

2.1. Innovation

As a point of departure in building up the theoretical foundation for this study, it is important to discuss how innovation should be understood in the museum context and what opportunities for innovation there are in this sector. Innovation has turned into an indispensable tool enabling museums to adapt to the paramount changes that have taken place (Vicente et al., 2012). Changes in consumer behavior and fast technological advancements are disruptive forces across many industries, including the cultural sector (Bakhshi and Throsby, 2010). These are pushing museums to reassess their strategies and develop new ways of conceiving the relationship with their audiences (Bakhshi and Throsby, 2010). According to a study prepared for the European Commission (KEA European Affairs, 2019), innovation lies at the heart of cultural and creative industries, involving three areas: technology, business model, and social innovation. The same study highlights the opportunities for innovation provided within the cultural and creative sectors by the fourth revolution, through its combination of the digital and the physical dimensions (KEA European Affairs, 2019). It is important to note that, as Bakhshi and Throsby (2010) pointed out, unlike other industries, cultural institutions lack a “clear” definition of innovation and, as Della Corte et al. (2016) observed, terms such as innovation may seem unexpected when they pertain to museums. This is tied to the fact that museums are institutions endowed with specific features (Camarero and Garrido, 2011). Consequently, there is a gap in knowledge about the ways in which they engage with, implement, utilize, and contribute to processes of innovation (Bakhshi and Throsby, 2010). Nevertheless, several

conceptualisations have emerged, converging to the idea that in the museum context should be understood as a form of integrating new systems, technologies, or processes that influence "both how the museum is run and how the exhibits are presented to the visitor" (Vicente et al., 2012). In line with this, Eid (2016) defined museum innovation as the creation of new and improved products, processes, or business models. Drawing upon these conceptualizations, several forms of innovation in the museum setting can be identified. Camarero and Garrido (2012) distinguished three main types of innovation in museums, namely technological innovation, innovation in value creation, and organizational innovation. Similarly, Vicente et al. (2012) identified four categories: organizational innovation, artistic innovation, technological innovation in management, and technological innovation in visitor experience. The latter form of innovation will be the focus of the present study, as it relates to adoption of technologies to innovate the visitor experience. Even though the field of study remains underexplored, in the last few years there has been an increasing interest in how new forms of technology can help innovate the visitor experience. Trunfio et al. (2022, p. 2) postulated that the "technology-driven innovation" has a "systemic effect" on the visitor-museum relationship. In this sense, technological innovation is a strategy to address visitor expectations. In the next section, technological innovation will be further discussed, by zooming into leveraging emerging technologies in the museum context, museum strategy, and innovation processes.

2.1.2 Leveraging emerging technologies

Bakhshi and Throsby (2010, p. 9) acknowledge the fact that emerging technologies constitute "the most radical avenue for innovation" when it comes to offering new types of artistic experience for customers. As highlighted by The Network of European Museum Organisations (2020), there are vast opportunities for innovation and experimentation employing advanced technologies and considering inclusive partnerships between the cultural, creative, and technology sectors. Implementation of emerging technologies is a key tool for museums to innovate and to adapt to changing forms of consumption. In support of this view are reports on the future of the museum sector commissioned by museum associations, which state that the number of museums is likely to decline unless they are able to implement new technologies (Weide, Meijer & Krabshuis, 2010). In spite of the fact that the adoption of emerging technologies in museums remains a complex topic at the center of debate between museum

professionals, technology has turned into a major driver for enhanced visitor experience (Shehade & Stylianou, 2020).

The implementation of emerging technologies by museums started in the 1990s and rose at a fast pace, aligning to society's rapid popularization and adoption of emerging technologies after the turn of the millennium (Bakhshi and Throsby, 2010). The broad umbrella term "emerging technology" designates all futuristic developments that have propelled a new wave of paradigm-changing innovation. Its popularity in both academic and public debate can be certified by the numerous scholarly publications, policy papers, and news articles that mention the term. While there is no general consensus in academia over what qualifies a technology as emergent, Rotolo et al. (2015) identify five defining attributes: (i) radical novelty, (ii) relatively fast growth, (iii) coherence, (iv) prominent impact, and (v) uncertainty and ambiguity. These attributes were identified after examining a wide body of literature concerning the topic and alternative definitions provided by scholars, especially from the field of innovation studies. Overall, emerging technologies are assimilated to new technologies that are still under development and have a perceived power to change the status quo and to drive colossal innovation and growth, including solutions like Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), Blockchain, Big Data, Internet of Things (IoT), and Robotics. Undoubtedly, emerging technologies have generated huge potential for the museum sector, providing alternative mechanisms for interaction with the visitors and new directions for experimentation (Eid, 2019; Shehade & Stylianou, 2020). Technology starts to be part of the message, haaving at the same time the role of the medium and the content (Stylianou-Lambert et al., 2022). Nevertheless, several concerns surrounding technology warrant attention. Connected to this, a core aspect in the study of technology is the matter of agency (Dafoe, 2015), as linked to human-technology interaction. In this regard, some questions crystalized in pre-1980s academic debate: *how much influence do we have over the instruments we employ, and thus our production processes, social interactions, and system of beliefs? To what extent are current technologies imposed on us?* Many technology experts considered the possibility that technological change could be an uncontrollable, society-driving force, where technology advances autonomously, separated from social influence- thus determining the evolution of society by its own internal logic (Kline, 2001), forecasting boh utopian (Negroponte, 1995) and dystopian scenarios (Rifkin, 2004). This perspective has been heavily contested and regarded as

overly simplistic or extreme in more recent debates (Dafoe, 2015). Scholars give preference to social constructivist approaches, critiquing and challenging technological determinism by drawing attention to issues such as social context, human agency, interpretivism, and contingency (Dafoe, 2015). In this sense, the constructivist scholarship has offered plenty of convincing arguments for the social shaping of technology and the role played by socio-historical context, demonstrating the unlikeliness of reductionist technological determinism. In line with these understandings, this paper adopts a constructivist perspective on technology adoption, rather than a deterministic one.

Moving beyond technological determinism arguments, technologies are not thrust upon passive users, but can be proactively exploited by creating a space for technological possibilities, alternatively called *affordances* (Russo, 2018).

Another important idea that has formed in the debates about emerging technologies since the late 1990s is that of the "technology trap", signifying the pursuit of technology for its own sake (Šola, 1997). Relating to this, Arthur (2018) explains that several museums have been blamed for adopting new technologies just because of their relative availability. These situations reveal museum practices where interactivity turns into "an end in itself, where the activity eclipses the goal of using the technology" (Arthur, 2018, p. 254). For this reason, it is important that technology is approached as a tool that supports the museum exhibition, rather than as a goal in itself. The issue of agency is, once again, an important factor when leveraging new forms of technology.

2.1.2. Strategic approach to innovation

Can technological innovation represent a strategic tool for museums? Now that several theoretical understandings about technological innovation have been introduced, it is important to point out what role technological innovation in visitor experience plays for strategic positioning.

Emerging technologies are employed by museums to expand audiences and generate new visitor experiences (Camarero and Garrido, 2012). Hence, this form of technological innovation is in close connection with value creation. Essential to any strategy is measuring value, which

can be accomplished by defining the goals of museums (Porter, 2006). As revealed by Porter (2006), visitor experience can be found among these goals, relating to the level of interactivity, the degree and sophistication of the information offered, and the amount of ancillary services. The implementation of technology should add value to the visitor experience, opening up opportunities for new types of interaction with the museum (Eid, 2019). The experience is regarded as a strategic challenge within cultural and creative industries (Pellegrin-Boucher and Roy, 2020). Being placed at the heart of strategic thinking of cultural heritage institutions, visitor experience can be a source of competitive advantage. According to Porter (2006), the visitor experience is a central objective for museums, useful when considering strategic positioning. Hence, the technological innovation in visitor experience represents a strategic opportunity, being a source of higher levels of competitiveness. Indeed, this perspective aligns with studies which have highlighted that innovation seems to be a proper opportunity for gaining competitive advantage in the case of museums (Della Corte et al., 2017).

As highlighted by Porter (1996, p. 64), competitive strategy means "deliberately choosing a different set of activities to deliver a unique mix of value". Museums seek to be unique in the experiences that they provide to their visitors. As a strategic approach to innovation, museums can "differentiate themselves based on the experience they offer" (Kotler et al., 2008). Differentiation is a generic competitive strategy theorized by Porter (2001) as a method to gain a sustainable strategic position by providing unique added value to consumers. The use of new forms of technology to innovate the museum visit experience can constitute a key element of a museum's differentiation strategy. This translates into a notable possibility to improve strategic position and gain competitive advantage, given that museums are in permanent competition with a wide variety of leisure-time options that include not just other museums, but different forms of leisure that seek to "buy" consumers' time. Conclusively, museums can use technological innovation in visitor experience as a source of competitive advantage by adopting a strategy of differentiation in terms of experience. The key is to create value in the experience that is not common, which, in effect, differentiates the institution from others.

2.1.3. Innovation processes

Now that the role of innovation for strategic positioning has been clarified, there is a suitable moment to introduce innovation processes that influence how visitor experience is

strategically capitalized on. Impactful innovation lies at the "sweet spot" where desirability, feasibility, and viability intersect, as suggested by the prominent framework proposed by industrial design company IDEO. The act of balancing them out can be done by using design thinking, a human-centered approach to innovation, which can be defined as a non-linear, iterative process to create innovative ideas and to conduct prototyping and testing, reason why design thinking has generated substantial interest in both industry and scholarly debate, as it provides a new approach to innovation (Micheli et al., 2019). Design thinking has been regarded as the best way to be innovative within the managerial realm (Johansson-Sköldberg et al., 2013), yet a more inclusive definition proposed by Simon (1969, p. 55) stresses the fact that "everybody designs who devises courses of action aimed at changing existing situations into preferred ones". At its basis, design thinking is founded on a problem-solving orientation, underpinned by challenging the norm, optimism, and treating constraint as inspiration (Micheli et al., 2019). A trademark of design thinking is a focus on iteration and experimentation, promoting "trial-and-error learning through iterative forms, prototyping, and trials that test a range of possible solutions with end-users" (Beverland et al., 2015, p. 593). Other important attributes include creativity, blending rationality with intuition, and using a human-centered approach (Micheli et al., 2019).

The human-centered approach is key, as it denotes- in the context of tourism destinations- that visitors are primordial when designing the exhibition (Tussyadiah; 2017). Along with the problem-solving orientation and the iterative approach through prototyping and testing, it translates well to the museum context, as it can provide solutions for innovating the visitor experience in a way that is closely linked to the visitor/technology user. These innovative processes support the museum's end goal of gaining a strategic position by differentiating the experience that it offers.

2.2. Extended Reality (XR)

So far, this chapter has discussed technological innovation in more general terms. This section aims to zoom into a particular type of emerging technology that constitutes the focus of this study, namely XR. This section is meant to introduce theoretical discussion about XR technologies affordances for the museum context.

Amongst the innovations associated with emerging technologies, the disruptive power of new realities is considered to have the most powerful effect in the museum sector (Trunfio et al., 2022). Extended reality (XR) as a collective term refers to environments in which forms of reaching "beyond reality" exist (Margetis et al., 2020), eXtending the physical reality with synthetic elements, which can be partial or total (Skult and Smed, 2020). In the current state of XR, three categories of reality enhancements can be distinguished: virtual reality (VR), augmented reality (AR), and mixed reality (MR). As Margetis et al. (2020, p. 3) suggest, "this type of intersection between the real and the virtual generates ample opportunities for XR applications to facilitate an entirely new 'reality' space to interact with and innovate inside of". Research focusing on the role of XR technologies in museum practice includes a diverse range of issues such as technology acceptance and user requirement (Han et al., 2018), cultural determinants for visitor behavior (Chung et al., 2018), and visitor engagement, experience, and satisfaction (Han et al., 2018; Trunfio & Campana, 2020; Trunfio et al., 2022). Specifically within the cultural heritage context, recent studies have investigated the opportunity of adopting cutting-edge XR technologies for the enhancement of the visitor experience (Jung et al., 2016; Tom Dieck and Jung, 2015), demonstrating how these can fill an apparent lack in traditional museum exhibitions (Giannini and Bowen, 2022) and enhance competitiveness (Han et al., 2014; tom Dieck and Jung, 2015).

An important observation relates to the idea of the "technology trap" previously introduced in this chapter. XR technologies, similarly to other emerging tech, lack intrinsic value, but rather achieve meaning in context and via the content they bring (Schavemaker et al., 2011). For example, when discussing AR, Marques and Costello (2018) reveal that there is still a certain level of skepticism in the museum world regarding its capabilities. This can be caused by the fact that the technology remains a "relative novelty" and "software products and support have been unstable" (Marques and Costello, 2018, p. 1). General concerns and challenges relating to application of XR technologies in museums include assumptions such as: *gimmickry* (Marques and Costello, 2018)- relating to the idea that commercial aims may cause museums to incorporate XR bypassing a critical consideration about the actual improvement on the visitor experience (Matuk, 2016), inducing a negative image of museums becoming theme parks overly focused on entertainment (Ballantyne and Uzzell, 2011)-and *detraction or replacement of the museum experience* (Marques and Costello, 2018), understood as a form of disconnection of the

visitor from the artwork, where engagement slides into distraction (Marques and Costello, 2018). However, there have been attempts to probe the validity of these assumptions through empirical research- such as the one undertaken by Marques and Costello (2018)-which conclude that these concerns can be eliminated through proper visitor experience design. This brings into attention the idea that purpose and design are of utmost importance when implementing XR for innovating the museum experience (Marques and Costello, 2018). In line with this view, Tom Dieck and Han (2022) suggest that XR applications that are solely adopted for marketing goals are prone to disappointment, failure, and consequent negative visitor experience. However, if implemented well, these

In the following subsections, three topics of interest will be individually introduced: the reality/virtual continuum, VR and AR. VR and AR receive a separate discussion as the two forms of technology are developed with different goals and features and it is important to briefly highlight their particularities, as they can be differently used for innovating the museum visitor experience.

2.2.1. Redesigning the reality-virtuality continuum

Since its introduction in 1994, Milgram and Kishino's reality-virtuality continuum- called alternatively the mixed reality spectrum- has been employed to frame XR research (Skarbez et al., 2021). The concept captures the idea of a scale that begins from a real environment and gets gradually to a point of a completely virtual environment, having augmented reality and augmented virtuality in between (Milgram and Kishino, 1994). The concept has been used to explain environments that fall along this scale, blending elements of reality and virtuality, to a higher or lesser extent (Margetis et al., 2020). The reality- virtuality continuum showcases the possibility for the real and the virtual to co-exist through virtual environment technology. XR technologies have radically transformed the human-interaction paradigm, redesigning the physical-virtual continuum by adding new forms of interaction and providing an additional layer of virtual enhancement (Trunfio & Campana, 2020). Tremendous potential resides in their ability to create immersive experiences for the visitor by blurring the lines between the real and the virtual spaces (Jung et al., 2016). These XR technologies help the museum tackle the physical

environmental limitations when displaying its works and by offering new opportunities to virtualise and augment the traditional visitor experience (Trunfio et al., 2022).

When it comes to XR technologies and the redesign of the reality-virtual continuum, a brief discussion about the changing meaning of place and the concept of dual reality is necessary. In contemporary scientific debates, the concept of place evolved to accommodate a notion that emerged in postmodern times: the "non-place". Linked to this is the idea that space can be detached from its physical dimension and the real-time spatial limitations can be eliminated (Sturken, 2004). Museums are characterized by Foucault (1970) as heterotopic places, single real places that juxtapose multiple spaces. Heterotopias are places that have dual meanings, bringing together the "absolutely real" to the "absolutely unreal". On this basis, the museum provides a dual reality when it comes to its exhibitions: on one hand the physical representation, on the other hand the virtual. According to this understanding of heterotopia, the museum is a constructed space, where the visitor's presence is productive and performative. The visitor assumes an active role by observing, exploring, and interacting, defining his or her personal experience (Chourdakis et al., 2019). This dual reality constructs the field of action for emerging technologies (Chourdakis et al., 2019). The connection between the physical and the virtual realms can be capitalized on through the creation of heterotopic immersive experiences that are interactive, creative, and open-ended. To support the idea of blending two worlds, the concept of "phygital" emerged, as a description of an interwoven physical-digital space (Neuburger et al., 2018). XR applications can be used to create phygital experiences, where the boundaries between the real and the virtual worlds are indistinguishable (Neuburger et al., 2018). XR opens up ways for overcoming the physical-digital dichotomy

2.2.2. Virtual reality (VR)

Popularized by Jaron Lanier in the mid-1980s, the concept of virtual reality (VR) has gained prominence as a terminology for a key technological breakthrough. Empowered by growing acceptance of the technology and more robust applications, VR is undergoing a renaissance in recent times (Evans, 2018). In a simplified manner, VR can be defined as a computer-generated environment that constitutes a total immersion in the digital space (Guttentag, 2010), representing the end of the spectrum in Milgram and Kishino's (1994) reality-virtual continuum. What differentiates VR from other media and communication is the feeling of

“being there”, the sense of presence” defined as the “perceptual illusion of non-mediation” (Lombard and Ditton, 2006). Subsequently, presence is created “by means of the disappearance of the medium from the conscious attention of the subject” (Mantovani and Riva, 2012). The uniqueness of VR technology lies in its capacity to produce perceptual simulations of real situations (Diemer et al., 2015) and to enable users to explore virtual environments.

Various VR applications have been created in tourism, such as the cardboard VR viewer, wearable VR head-mounted displays, and three-dimensional (3D) virtual tours accessible online on tourist destination websites (Hyun and O’Keefe, 2012; Wei, 2019). In the museum world, Shehade and Stylianou-Lambert (2020) assert that VR has undisputedly provided enormous opportunities on numerous levels, generating new options for museums to communicate with the visitors. The implementation of VR-based projects has been sharply increasing, with more museums wanting to cope with the challenges of the digital revolution and showing interest in technological innovation (Shehade and Stylianou-Lambert, 2020). VR applications opened up many possibilities for experimentation, based on the premises of openness, freedom of interpretation, accessibility, inclusion, and democratization (Shehade and Stylianou-Lambert, 2020). Main opportunities are discussed extensively in the literature, regarding alternative content delivery, experience personalization, and visitor participation. However, Shehade and Stylianou-Lambert, (2020) wonder if there is not a myopic focus on advantages and a slight disregard of the limitations.

A particular aspect relating to VR is the effect on the spatial and social experience of museums (Duguleană et al., 2019; Parker and Saker, 2020). While Shehade and Stylianou-Lambert (2020) point out that this topic remains understudied, they also stress the fact that it cannot be overlooked when discussing VR experiences. Space and social interaction are indeed two topics often revisited in museum research. Upon conducting a study with visitors who experienced a VR-based exhibition, Parker and Saker (2020) drew several empirical observations regarding the visitors' experience. On one hand, they highlighted a favorable experience of spatial and social autonomy that enable more immersion, as well as a sense of privacy letting the visitor be absorbed; on the other hand, they note down a perceived negative feeling of dislocation from the physical environment and an unfavorable reaction towards the inability to have the experience with another person (Parker and Saker, 2020). Drawing on these manifold

observations, Parker and Saker (2020) concluded that VR significantly transforms how physicality and sociality are experienced.

2.2.3. Augmented reality (AR)

AR is perceived by certain scholars as a type of VR (Guttentag, 2010), the two concepts being considered as strongly interconnected (Milgram et al., 1995). However, these two types of XR showcase fundamental differences, the VR and AR technologies being developed with different features and having distinct applications for visitor experience design. Using the reality-virtuality continuum developed by Milgram and Kishino (1994), AR can be understood as an initial phase when virtual elements are superimposed on the real environment (Voinea et al., 2019). As defined by Danado et al. (2015, p. 1), AR is: "a technology that allows the superimposition of synthetic images over real images, providing augmented knowledge about the environment in the user's vicinity which makes the task more pleasant and effective for the user". Unlike a fully immersive artificial experience typical of VR, AR technology demonstrates the capacity to generate positive effects on the user by offering virtual information that is superimposed on the real, physical view, without compromising it *(*Han et al., 2013). A good exemplification of AR technology is a mobile application that generates overlaid audio-visual content, 3D animations, and avatars (Wei, 2019). In tourism, smartphone AR applications have been growing in number, demonstrating the success, as well as the ease to be implemented, if compared to VR technology applications (Yovcheva et al., 2012). Emblematic for presenting AR to a mass audience and anticipating its disruptive force is the success of the Pokémon GO AR game, which "swept the world in 2016" (Kane et al., 2018; Margetis et al., 2020; Wingfield & Isaac, 2016). Besides changing the gaming industry, Pokémon GO paved the way towards appreciating the potential of AR as a medium that provides new layers of interpretation (Ding, 2018).

When it comes to the museum sector, AR has been considered an effective "tool for innovation" of the museum visitor experience (Schavemaker 2012). Elinich (2011) points out that the potential of AR lies in blending "the observational and interpretational" elements of experiencing an exhibition. Several key advantages associated with AR in museums are reviewed by Ding (2018, p. 4-5): "endless layers of information", "powerful tool of

engagement", "creative tool of education". These are also driven by the fact that AR applications are easy to implement by museums, and to use by museum visitors (Ding, 2018). An interesting application highlighted in the literature is the "Bring Your Own Device" (BYOD) model (Roussou and Katifori, 2018), where the hardware isWhile demonstrating clear advantages on the implementation side because the visitor already possess the hardware, the BYOD model offers benefits directly to the visitors, such as increased accessibility and frictionless experience. Nevertheless, linked to the BYOD model there are several concerns regarding distraction of attention, limited user control, and the navigational structure of the experience (Roussou and Katifori, 2018).

2.3. Visitor experience

The technological innovation in visitor experience with a focus on XR technologies has been already introduced in the previous sections of this chapter, yet an issue that needs further inquiry is how visitor experience can be conceptualized. This section aims to provide a connecting link to the previous ones, by zooming into visitor experience and resting on several key theoretical assumptions about the experience economy and experience-based tourism.

2.3.1. Experience-based tourism

From a theoretical standpoint, a critical step for discussing visitor experience is understanding recent developments and changes in the domain of experience creation. This section draws on more broad understandings of experience in the context of tourism applied to the case of museums as cultural tourism destinations. As experience is proposed as a new framework in tourism (Stamboulis and Skayannis, 2003), an increased interest has been manifested towards analyzing and strategizing experiences for tourist destinations. Stamboulis and Skayannis (2003) contended that this new perspective on experience initiated a new strategy paradigm of "new tourism", providing salient opportunities for technology.

Within this framework of experience-based tourism, two elements are of critical importance. Firstly, visitor-centered processes are deemed as essential in tourism experiences, therefore placing a crucial role on the visitor. As active consumers of the experience, the visitors co-create value together with the destination (Prahalad & Ramaswamy, 2004). Secondly,

experiences are not just co-created, but technology-mediated (Tussyadiah & Fesenmaier, 2009). Therefore, technology can facilitate richer experiences (Gretzel & Jamal, 2009). According to the experience-based paradigm in tourism, destinations are "theaters" of interaction where the experience takes place, the tourists having the role of "actors" that participate actively in the experience creation process (Stamboulis and Skayannis, 2003). This direct interaction between place, theme, and tourist postulates the importance of understanding the experience as a co-created dynamic process. Next in this section, the concept of the experience economy will be introduced, followed by a brief theoretical discussion about experience and museums.

2.3.2. Experience economy

In today's world, possessions matter less and experiences are valued more. Pine and Gilmore (1998)'s "experience economy" has been recognised as a predominant concept in the experience domain. The experience economy consists of four realms of consumer experience- depending on the level of participation and connection- namely esthetics, entertainment, escapism, and education and envisions ecosystems in which stakeholders design, stage, and consume experiences- instead of product and services- on a regular basis (Pine and Gilmore, 1998). Each individual experience is manifested through the four realms in a distinctive way. A tourist destination should be positioned in a "sweet spot" in between all four realms, delivering experiences that include all four (Stamboulis and Skayannis, 2003). Sundbo (2009) argued that in the experience economy, the opportunities that technology exhibits have a particular nature, as technology is employed to create virtual realities. Sundbo (2009) further suggested that technology is important in the experience economy, as new technological possibilities determine innovations that are subsequently contextualized based on the social dimensions.

As a consequence of the theoretical relevance of the experience economy, various scholars have studied the concept in relation to innovation and technology (Neuhofer, 2013; Sundbo, 2009). For example, Sundbo (2009) studied how innovation theory can be applied to experiences. At the same time, there have been certain reactions that advise revisiting the experience economy concept, cautioning against focusing on "staging" experiences that become overly commercial, superficial, or artificial (Binkhorst and Den Dekker, 2009; Gilmore and Pine, 2007). To the contrary, experiences should be contextualized and authentic, offering freedom and self-expression (Binkhorst and Den Dekker, 2009), a possibility for constructing a "narrative

of the self" (Giddens, 1990). In relation to this, the concept of creativity has been put forth (Florida, 2002; Richards & Wilson, 2006) and also the concept of co-creation, which constitutes a separate theme that will be analyzed later in this chapter.

The experiential component has a relevant role in the museum setting as "museums have always been an experience" (Gilmore and Pine, 2007). Nevertheless, in recent times, museums are trying to redefine their position in the experience economy, marked by fierce competition between a variety of leisure opportunities. The adoption of emerging technologies has turned museums from object-centered to experience-centered spaces (Parry, 2013), re-shaping the debates on what museum experiences are and what they should convey in modern times. This constitutes an important theoretical insight that lies at the foundation of the visitor experience conceptualization.

2.3.3. Experiential visitor-centric model

Adopting a user-centered approach and a visitor-oriented perspective affects understanding how experiences are constructed and designed in museums. Therefore, a key premise is to place the visitor in the center, simultaneously with reflecting on the affordances of emerging technologies such as XR. Combining theoretical insights already introduced in this chapter, a visitor-centric model enhanced by XR technology is proposed. The model is designed to innovate the museum visitor experience, constituting a form of strategic differentiation. It is composed of three dimensions: visitor engagement, visitor participation, and visitor co-creation. These dimensions should be treated in relation to one another, as the literature suggests that engagement, participation, and co-creation are not mutually exclusive, but rather sympathetic concepts, sharing numerous overlaps and strong relationships. Next, they will be evaluated as individual themes.

2.4. Visitor engagement

Engagement is a firmly established topic within the field of tourism (Taheri et al., 2014) and commonplace in museum studies. The reason why engagement constitutes a core part of the visitor experience design is because better engagement enhances the overall visitor experience

(Taheri et al., 2014; Welsh, 2005). In recent studies, engagement is regarded as a key characteristic that underpins XR technologies applied in the museum sector (Tom Dieck and Han, 2022).

According to Han et al. (2019), engagement entails various mental processes, all connected to the feeling of being 'in the moment'. Engagement is a complex theoretical construct closely connected to ideas such as visitor identity and sense-making (Edmonds et al., 2006). According to Welsh (2005), engagement concerns the various ways in which visitors use museums to create images of themselves. Drawing on this assumption, visitor engagement deals with the reciprocal relationships that form and exist between the museum and the visitor (Welsh, 2005). Through the use of technology, museums can construct experiences that are meaningful for the visitor and hence engage him in a process of dialogue with the museum throughout all the stages of the visitor journey. Edmonds et al. (2006) discuss engagement using three attributes: attractors, sustainers, and relaters. In the context of technology applications, "attractors" should be understood as the elements that incentivize the audience to observe the innovation in the first place, have "attraction power" (Bollo and Dal Pozzolo, 2005), "sustainers" as those elements that maintain the audience engagement during a first encounter, having "holding power" and creating visitor "hot zones" (Bollo and Dal Pozzolo, 2005), and "relaters" as elements that support the growth of an ongoing relationship between the audience and the technology-mediated product on future instances (Edmonds et al., 2006), allowing the "hot zone" to remain hot during return visits. Next in this section, several sub-themes of visitor engagement are broken down for a nuanced understanding of how XR technologies can engage the visitor.

2.4.1. Storytelling

Existing literature supports the idea that XR technologies can be used to open up possibilities of storytelling in museums that engage the visitor in innovative ways [insert sources]. When discussing visitor engagement for tourist destinations, Gretzel et al. (2006) acknowledged that people love to tell and hear stories. The greatest amount of the knowledge used on a daily basis in communication and reasoning is made up of stories (Schank and Berman, 2003), for these help understanding and explaining the world. Telling stories is a valuable way of "transforming various isolated pieces of sensory and cognitive information into

a coherent whole, allowing …[the visitor] to derive meaning from it" (Gretzel et al., 2006, p. 14). Visitor engagement can be obtained through storytelling, as people are particularly responsive to information in narrative format (Green and Brock, 2002). In his work on digital storytelling, Lambert (2013, p. 54) asserts that: "We want stories. We love stories. Stories keep us alive. Stories that come from a place of deep insight and with a knowing wink to their audience, and stories that tease us into examining our own feelings and beliefs, and stories that guide us on our own path. But most importantly, stories told as stories". Aligned to this line of thinking, Silvaggi (2021, p. 42) agrees that "stories engage us" and that, subsequently, "the focus for museums should be more on the story". This also comes down to the fact that stories are a form of holding attention and dealing with instances of hyperinformation (Silvaggi, 2021).

A relevant consideration is that technology can facilitate effective forms of storytelling. Silvaggi (2021) stresses the fact that new technologies offer museums more means for telling stories. Content creation and storytelling have been evolving in tandem with the advance of technology, showcasing new dynamics (Shehade and Stylianou-Lambert, 2020). XR can be used to tell stories in the museum setting, enabling a change of perspective. Notably, Okanovic et al. (2022) revealed that XR technologies are more efficient in transmitting information if complemented by engaging storytelling. In relation to this, the concept of spatial storytelling has been introduced with emphasis on how interactive storytelling can modify the visual communication in museums (Del Falco and Vassos, 2017).

2.4.2. Immersion

The immersion potential of XR technologies has been well documented. Immersion assumes that one is being drawn into an "embodied relationship" with the environment and "transported into another realm or state of perception" (Bartlem, 2005). In museums that have technologically-generated immersive exhibitions, immersion can be conceptualized as a form of engaging the visitor, explained as a feeling of presence (Jung et al., 2016), "becoming physically or virtually a part of the experience itself" (Pine and Gilmore, 1998, p. 31) or, in other words, being "enclosed" or "enveloped" by the "technologically-mediated architecture" (Bartlem, 2005). In media studies, the concept of *presence* has been used as a measurement of the level of immersiveness. Despite acknowledging that the concepts are probably closely connected empirically, Slater (2003) makes an attempt to differentiate between the terminologies, arguing

that immersiveness denotes "what the technology delivers from an objective point of view" (Slater, 2002, p. 1), whereas presence is "the human reaction to it" (Slater, 2003, p. 2). Thus, the first concerns the technological and the later the psychological (Parker and Saker, 2020). There have been various attempts to define the concept of presence, converging to the idea that it relates to the psychological impression of non-mediation (Ermi and Mäyrä, 2011; Lombard and Ditton, 1997). In line with this interpretation of presence, in the field of museums immersion can be defined as a multisensory experience that has the ability to "transport" to another time, place or situation (Gilbert, 2002). Popoli and Derda (2021) assert that this is a new dimension of experience design, of paramount importance. Research about XR technologies actively examined the feature of immersion in esthetic and the escapist experiences (Lee, Chung, & Jung, 2015; Lee, Chung & Koo, 2015). Well-designed XR environments open up possibilities for enhanced visitor experiences (Guttentag, 2010), with a strong immersive character. In line with this, Margetis et al. (2020, p. 2) argue that due to their strong immersive nature, XR technologies have the ability to "truly innovate museum experiences".

The idea of *seamlessness* is mentioned in the literature as a form of enhancing immersion by providing the perceptual impression that reality and virtuality blend together in a natural, unnoticeable way (Margetis et al., 2020). In this sense, while the immersive experience modifies and extends notions of the body and perception via technological mediation (Bartlem, 2005), the visitor is not aware of the technology. In this sense, the experience is engaging the visitor on a sensorial level, but also on emotional and cognitive levels. Next, emotional and cognitive engagement will be discussed as the last sub-themes of visitor engagement.

2.4.3. Emotional engagement

The importance of emotional engagement has been extensively acknowledged and studied in the field of tourism, as emotions have been considered an element that shapes the touristic experience and contributes to visitor engagement (Falk, 2021; Li et al., 2014; Moyle et al., 2017). Capturing this fundamental idea, Bastiaansen et al. (2019) acknowledge that emotions are "core building blocks of experience". As a theoretical construct, 'emotional engagement' is hard to define since there is a lack of consensus regarding the meaning of 'emotion'. In an attempt to define the term, scholars agree on the fact that emotion is made up of three

components: subjective experience, an expressive element, and psychological arousal (Li et al., 2014).

In a 2021 report prepared by the Network of European Museum Organisations (NEMO), emotions in the context of museum visiting are comprehensively explored, more specifically their role in audience engagement. Several key contributions in this direction belong to Sani (2021), who claims that emotional engagement is a "precondition" for any effective and authentic museum visit, and that museums should consider that visitors are different and have distinct emotional triggers. Stemming from this, Sani (2021, p.4) introduces the idea of the "empathic museum"- based on the premise that museums should be teaching the audience to be emotional and empathetic- revolving around ideas such as "inclusion, social justice, equality, and representation". Likewise, Mazzanti (2021, p. 8) endorses the fact that emotions, together with empathy, are turning into a trend, and museums need to "invest in a strategic approach of audience engagement to increase and diversify audiences, placing people at the centre of museums of the future". Greppi (2021, p. 32) supports the view that emotions occupy a central position in experience design, yet their position should be understood as a"strongly dynamic, flexible, fluid position", one that does not belong fully to neither the museum nor the visitor, but is rather "at the heart of the dialectical relationship between content, container and visitor".

A certain element has been praised as important when discussing emotional engagement: the first-person character of emotions (Mazzanti, 2021), thus the constructivist nature of emotional engagement (Barret, 2017). In the museum environment, this translates into a need to let visitors' emotions form freely, without guiding them, but rather designing museum experiences in an engaging manner, one that provokes the visitor to "discover, imagine and feel the emotion they like", thus seeking the "'trigger-emotions' effect" (Mazzanti, 2021, p. 11). This constructivist nature of emotions provides opportunities for new technologies to be innovatively used in the museum experience design processes, points out Mazzanti (2021). Greppi (2021, p. 33) advances the idea of avoiding an "excess of technology", but rather opt fo a "museum for all the senses" that "breathes, pulsates, vibrates, resonates …to give each visitor time, space, the pleasure to imagine, taste, rejoice in their emotions". Reflecting on this, XR technologies should allow visitors to discover the museums at an emotional level by maintaining the emotional value pertaining to the place itself.

2.4.4. Cognitive engagement

While emotional engagement has been more popular in academic debates in recent times, the cognitive dimension has been a long-lasting theme when it comes to visitor engagement (del Bimbo, 2021). Core ideas underpinning cognitive engagement are rationality, active learning, transferring of knowledge (del Bimbo, 2021), and the interpretative, intellectual character of the experience (Pekarik et al., 1999). To certain scholars, cognition cannot be dissociated from emotion, hence it comes naturally to introduce it right after the theme of emotional engagement. A case in point in Greppi's (2021, p. 33) argument that emotion is "the first engine of every cognitive process."

An important element that relates to cognitive engagement is contextualization, as explained by Pekarik et al. (1999)- a form of enhancing the museum experience by "contextual presentation". Cognitive engagement can be understood through other elements as well, such as a boosted desire for knowledge, linking to aspects such as surprise (del Bimbo, 2021), critical attitude and questioning or curiosity (Greppi, 2021). An idea that relates to the theme of immersion previously introduced in this section is that of "the state of cognitive transition" (Bartlem, 2005), that is immersing the visitor at cognitive level provides enhanced experiences.

When discussing cognitive engagement in visitor experience design, it is important to note that XR technologies can augment knowledge, adding extra layers of information and enhancing accessibility for the visitor. However, there are concerns raised in the literature that XR environments can "overtax cognitive resources" (Geroimenko, 2021, p. 14). In relation to this, scholars raise concerns about visitor fatigue (Marques and Costello, 2018) and user cognitive overload (Ko et al., 2013).

2.5. Visitor participation

A next theme introduced is visitor participation. The "participatory museum" envisioned by Simon (2010) proposes a framework of analysis that gravitates around the idea that the visitor should be turned from a passive observant to an active participant in the museum experience. In the present paper, participation is regarded as a further step from engagement, as the visitor is not just presented with a compelling story, immersed in the experience, and triggered a strong

emotional and cognitive reaction, but he is actually pushed to participate, by interacting, playing, and personalizing.

Contrasting the image of the visitor as a spectator or passive sightseer (Antón et al., 2018), participation proposes a situation where the visitor becomes an actor, an explorer of multisensory experiences, somebody who seeks to interact (Campos et al., 2015). Participatory experiences enable visitors to *do* things, instead of exclusively *looking* at things (Azevedo, 2009; Eraqi, 2011), which is an important change of paradigm when it comes to envisioning the relationship between the visitor and the museum exhibition.

Edmonds et al. (2006, p. 308) pointed out the fact that participation is "much easier to promote than to achieve". Technology comes to fill in this gap and offer solutions that enhance overall visitor participation. Several elements that can drive visitor participation are discussed separately in the following subsections, in light of the applications of XR technologies.

2.5.1. Interactivity

XR technologies offer museum visitors possibilities to interact with the content in an innovative manner, either in the real or virtual museum environment through interactive designs. In order to grasp the meaning of interactivity, a short theoretical discussion about interaction is necessary. Interaction can be defined as the interchange and exchange between art systems and people (Cornock and Edmonds, 1973), having non-material properties, but rather relating to experience, perception, and understanding (Edmonds et al., 2006). Cornock and Edmonds (1973) found several categories that describe the types of interaction that form between the artwork, the artist, the audience, and the environment, out of which the dynamic–interactive stands out. This type is of interest for this study, as it describes how the human viewer has an active role in the experience design (Cornock and Edmonds, 1973). When it comes to interactivity, Ciolfi and Bannon (2002) asserted that the traditional "rules" of behavior in a museum are suspended. It is possible to experiment new forms of interaction, touching and looking at the object in close-up. This triggers curiosity, stimulates a sense of active discovery, and encourages the visitors to participate in the experience (Ciolfi and Bannon, 2002). However, Macdonalds (2007) revealed that interactive 'hands-on' exhibits may lead to perceptions that the exhibition is 'for children'. [insert section on XR and interactivity]

2.5.2. Game design

The potential of XR technologies combined with games to enhance the visitor experience has been acknowledged in an expanding body of literature (Camps-Ortueta et al. 2021; Doukianou et al., 2020; Hammady et al., 2016; Vayanou et al., 2018), which explains the coining of some terms such as "the museums of gamers" (Aydin and Schnabel, 2016). Drawing upon theories of serious gaming and gameful learning that study internal motivations of players, game design in the museum setting has been extensively documented as a form of visitor participation. The connection between the game and the visitor is key, as "there is no game without a player" (Ermi & Mäyrä, 2005). The "gameplay experience" is understood as an ensemble consisting of the player's "sensations, thoughts, feelings, actions, and meaning-making in a gameplay setting" (Ermi & Mäyrä, 2005). Therefore, for this type of experience, the player cannot be dissociated from the game, as he has an active role. Players are considered to enter the "magic circle", which is a concept firstly introduced by Huizinga (1938) and later on reframed and praised as the basis of game design and game experience (Salen and Zimmerman, 2003). Lately, this concept has been revisited with interest in the museum community and contested at times as a form of comprehending the museum visitor. The metaphor of the "magic circle" describes a bounded game space in which the user enters or which the user rather "creates" (Salen and Zimmerman, 2003), where specific game rules apply (Huizinga, 1938). Nevertheless, as Koljonen (2015) points out, in experience design the game space should not be conceived as a closed system, where strict boundaries are set. Indeed, when designing the experience, one key premise is that the visitor has started the game before he entered the magic circle itself. What happens previous to and after the game has a direct influence on the overall experience (Koljonen, 2015), therefore the pre-visit and post-visit phases should be considered in the game design.

When it comes to game design, a concept that has been heavily revisited is gamification. As a term, gamification originates in the digital media industries, being largely adopted since 2010 (Deterding et al., 2011). In general understanding, gamification is defined as "the adoption of game technology and game design methods outside of the games industry" (Helgason, 2010). The concept of gamification has been used in numerous fields, including experience design in the museum sector. Gamification as a research concept has been contested and attracted a negative connotation, especially within the game studies community (Deterding et al., 2011). The dissatisfaction stems from current forms of adoption and oversimplifications, leading to

alternative terms for the term, such as game elements design, alternate reality games (McGonigal, 2011), gamefulness or gameful design (Matallaoui, Hanner and Zarnekow, 2017). Another alternative to gamification is proposed through a different approach to game play is that of "meaningful play" (Salen and Zimmerman, 2003). Similarly, Nicholson (2012) defines the "meaningful gamification" alias "playfication" drawing on notions of play and ludos. At the core of this approach is the idea of "play", as opposed to "game". In play "the aim is play itself, not success or interaction" (Flaganan 2009, p. 5). Important for creating playful participation are the elements of "creative and transgressive play", so giving the players the freedom to"not just play within the given rules, but also play with the rules, to creatively and transgressively bend the experience to their own purpose" (Back et al., 2018, p. 37), to explore on their own terms, guided by intrinsic motivations (Nicholson, 2012).

Several challenges related to the adoption of play elements in the museum are laid out by Back et al. (2018). These include concerns shared by museum professionals regarding instances where play experiences are perceived as "distracting", "disconnected" from the physical exhibition, or "too superficial", thus affecting the learning experience (Back et al., 2018, p. 37). Even though these worries may not come true on the visitors' side, Back et al. (2018) point out that they are important to be considered for play experience design.

Several effective strategies for incorporating designs that blend XR with games have been presented in the literature. They are based on the idea that the visitor as a user and player needs to occupy a central position in the game design process. Moreover, the game design is an iterative process, where prototyping and testing are crucial. One consideration should be the heterogeneous nature of the visitors and treating game design in accordance with the differences between them (Camps-Ortueta et al. 2021). When it comes to on-site games, location-awareness has been regarded as an essential element for the delivered experience (Veyanou et al., 2018).

Reflecting on the literature insights, incorporating game elements offers great opportunities for innovating the visitor experience through different forms of visitor participation, but it is nevertheless not simple or straightforward to ideate and implement.

2.5.3. Personalization

Capturing the idea of "participation begins with me" of the participatory museum framework (Simon, 2010), personalization in the museum context is understood as the design of specific features based on the visitors' preferences (Luiten, 2021) and the creation of personal narratives (Gretzel et al., 2006) together with the visitor. Simons (2010, p. 32) stresses the fact that "it is important to get to know the visitors as individuals". As a consequence, the visitor experience cannot be the same, but should be matched to the uniqueness of each visitor. Similarly, Falk (2009) contends that the museum visitors differ and their identity influences the museum experience design, alongside the environment and the socio-cultural context of the museum. For this reason, it makes sense that personalization is regarded as a major global trend in museums during recent times [add source].

Baraldi et al. (2015) contend that museums lack proper tools for visit personalization and it is often a challenging task to design truly personalized experiences in the museum setting. Nevertheless, technology provides useful opportunities in this direction.
[section on possibilities for personalization to be added]

enhanced experiences and competitive advantages

2.5.4. Social interaction

When it comes to XR technologies, social connectedness is listed amongst one of the opportunities that can be capitalized on (Tom Dieck and Han, 2022). Museum experiences, like other tourist experiences, have a social dimension, based on the interpersonal relationships visitors cultivate (Campos et al., 2015). The social dimension of the experience plays a tremendous role (Cialfi and Bannon, 2002). Social interaction is considered to be a form of sharing thoughts and exchanging ideas that facilitate understanding and confirming each other's reactions (Falk and Dierking, 2016; Hooper-Greenhill, 1994; Pekarik et al., 1999).

2.6. Experience co-creation

A last theme linked to innovating the visitor experience through XR technologies that this paper introduces is co-creation. This concept is more and more prevalent in cultural tourism, being regarded as a key factor for tourist satisfaction (Sugathan & Ranjan, 2019) and as a form of adding value to the overall visiting experience (Jung and Dieck, 2017). Unanimously, recent studies in the field of tourism experiences underline the role played by the tourists in experience

co-creation (Neuhofer et al., 2012; Prebensen et al., 2013; Tan et al., 2013), drawing on consumer co-creation premises popularized by Prahalad and Ramaswamy (2004) as a new way of thinking about value creation. The key idea behind co-creation stems from the belief that the consumer is a co-creator of value (Dabholkar, 1990; Prahalad and Ramaswamy, 2004) and that value is placed on the experience of consumers (Prebensen & Foss, 2011). This aligns to the experiential perspective laid out in section 2.3. of this chapter. The importance of co-creation for cultural heritage places has been acknowledged by scholars (Binkhorst, 2006; Neuhofer et al., 2012; Prebensen, 2013). According to Caru and Cova (2007, p. 7), "consumers are not passive agents reacting to stimulus, but instead, the actors and producers of their own experiences." In the realm of museums- incorporating the insights on the experience economy previously introduced- co-creation can be understood as a form in which museum visitors are involved in the innovation of the museum experience, playing an active role in the process of creating memorable experiences by exercising choice (Ranjan and Ramaswamy, 2013). Adding XR into visitor experience design from the perspective of co-creation has been limited, yet certain frameworks have been proposed, such as the one of Jung and Dieck (2017). As scholars such as Neuhofer et al. (2012) pointed out, the co-creation of experience together with the visitors is not limited to the on-site experience, but rather starts and ends beyond the physical destination space. Therefore, co-creation can be conceptualized using a multiphase model, whose relevance is threefold: let the visitor co-create the experience before the visit, during the visit, and after the visit (Neuhofer et al., 2012). These three phases will represent three sub-themes of co-creation to be explored next. They all align to the vision of a collaborative design and reflect how XR technologies can be integrated in order for museums to co-create innovative experiences together with the visitor.

2.8. Conceptual framework

Based on the theoretical insights gathered in this chapter, a conceptual framework was elaborated on, presenting the main concepts that underpin this research (Figure 1).

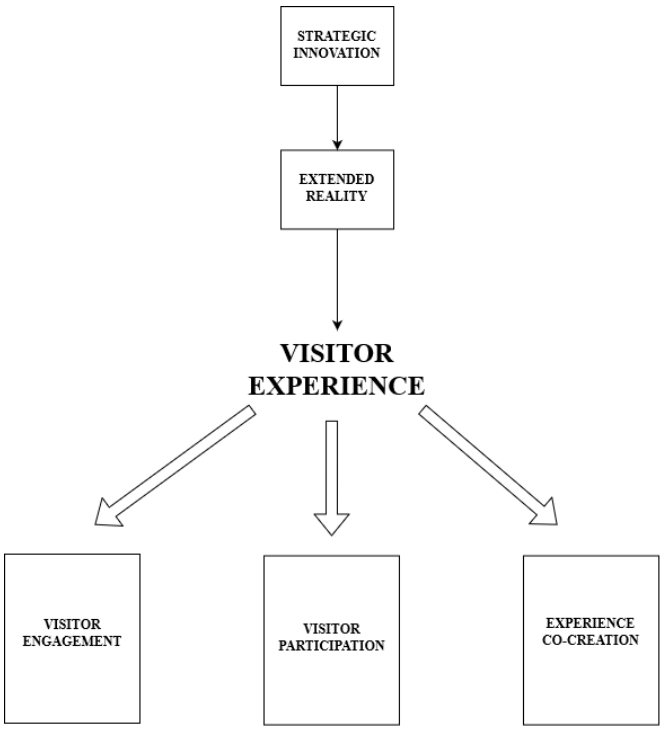

Figure 1- Conceptual Model

2.6.1. Pre-visit phase

This is an anticipatory phase that assumes the co-creation of a virtual experience before the museum visit (Neuhofer et al., 2012). Virtual environments have turned into appealing platforms for tourism destinations such as museums. In this pre-experience stage, museums can leverage XR technology to provide visitors with applications of VR prior to the actual visit. This can be a form of introducing the exhibition virtually, positively influencing the intention to visit (Jung and Dieck, 2017; Neuhofer et al., 2012).

2.6.2. On-site phase

During the visit, both virtual and physical experiences can be co-created. Neuhofer et al. (2012, p. 41) observed that in this phase "experiences reach new levels of interaction". In this context, the main affordances of AR applications are enhancing the experience through overlaid information, in which the visitor is let to participate actively in the content design. Leue *et al.*, 2015) highlighted that this could add value to the visitors' hedonic experience, simultaneously

with adding value to the learning experience. Main affordances of VR consist in using the technology for higher accessibility and interpretative functions (Jung and tom Dieck, 2017).

2.6.3. Post-visit phase

This is a recollection phase that involves the co-creation of a virtual experience after the museum visit. By enabling XR technologies, museum visitors can select certain parts of the physical museum exhibition that they would like to personalize and keep as a 3D souvenir after the visit (Jung and tom Dieck, 2017). Affordances are evident in the case of AR, which enables sharing the content online, thus co-creating the post-experience (Neuhofer et al., 2014). The *community building processes* are highlighted here as an important element that adds another dimension to personalization and contributes to the a*uthenticity* and *memorability* of the place (Jung and tom Dieck, 2017; **Neuhofer *et al.*, 2014**; **Minkiewicz *et al.*, 2014)**.

3. METHODOLOGY

This chapter lays out methodological considerations underpinning the present study. Firstly, it explains the research design and the rationale behind it, reflecting on issues of reliability and validity. Then, it provides details regarding data collection, operationalization, and data analysis. Lastly, several considerations related to research ethics are made.

3.1. Research design and rationale

In order to perform this study and to provide answers to the main research underpinning this study, qualitative research was considered the most appropriate methodological approach. This type of research attempts to explore phenomena in context-specific settings, where the researcher does not try to manipulate the phenomenon (Patton, 2002), nor quantify it (Strauss & Corbin, 1990). Unlike in quantitative studies, the research focus is not on causal determination, prediction, and generalization of findings, but explanation, understanding of nuances, and extrapolation to other comparable situations (Hoepfl, 1997). The purpose behind this study was to look into how museums use technological innovations such as XR technologies to innovate their visitors' experience in order to gain a strategic position. Without a qualitative approach, nuance and depth regarding the topic could not have been gained. This has been performed through expert interviews, a qualitative method for data collection that is helpful for uncovering

insider knowledge that cannot be accessed in other ways (Bogner & Menz, 2018). The choice for this method highlights the importance of looking into the experiences and patterns of thought of the interviewees (Flick, 2018) for gaining a deeper understanding of current trends in the museum sector regarding technological innovation, state-of-the-art applications of emerging technologies such as XR, and strategies for innovating the visitor experience. Interviews allow the researcher to understand the world from the subjects' perspective and to uncover the meaning behind the participants' experiences (Kvale, 1996). This method is preferred to others, as it provides the opportunity to gain empirical knowledge by engaging in insightful conversations with people who are deemed as relevant for grasping the topic under investigation and can provide a critical perspective on it. Because of their backgrounds and demonstrated experience, they can distill best practices, reflect on opportunities and limitations, and offer insights that could not be gained through the use of other research methods.

3.2. Reliability and validity

In order for this research to be valuable, it has to be open to critique and assessment, relating to the soundness of the method, the accuracy of the results, and the integrity of the conclusions (Long and Johnson, 2000). The fulfillment of this general research premise can be assessed by looking into the reliability and the validity of the study. Reliability relates to the level of consistency employed in the research process and the confidence in the data collection process (Long and Johnson, 2000). To ensure high reliability, the data was collected consistently, operationalizing the conceptual framework and standardizing the interviews based on the interview topic guide. Validity is based on the integrity of the research process and the accuracy of the findings with respect to the collected data (Long and Johnson, 2000). Plausibility, credibility, and weight of evidence all constitute metrics for evaluating the validity of the research (Long and Johnson, 2000). In line with these, the present study attempted to provide credible findings that show both theoretical and practical validity, and to reach conclusions that are robust with the study undertaken and reflect on its implications. The sample was carefully constituted and the entirety of the topic under investigation has been addressed.

As a side remark, several scholars have criticized the use of the terms reliability and validity in qualitative studies, proposing trustworthiness as a more suitable criterion (Maher et al., 2018). According to Guba and Lincoln (1989), the trustworthiness criterion is met through

four elements: credibility, transferability, dependability, and confirmability. They correspond respectively to the truth-value relation, the applicability, the consistency, and the neutrality of the research process. Adherence to these elements ensures a rigorous research process. Nevertheless, to avoid any confusion over the terms and criteria for analyzing qualitative research, the present paper considered reliability and validity as main evaluation criteria, while acknowledging that there is a debate in the methodological literature regarding the most appropriate terms to be used.

Overall, in order to adhere to methodological standards and ensure high reliability and validity, this study respected a few aspects in the research process. Firstly, it sought to transparently present the theoretical foundation behind the study by designing a conceptual framework and subsequently operationalizing the concepts. Secondly, it tried to describe the research method and the steps of data collection and analysis in a highly detailed and clear manner. Thirdly, the experts selection procedure was carefully made, based on the relevance of each participant to the research topic. Subsequently, the data was analyzed through a rigorous process of coding, afterwards laid out in the results chapter using accurate explanations and including direct quotations from the participants to support arguments. Lastly, in order to reduce researcher bias, no preconceived ideas were prioritized, nor were any of the findings influenced by the researcher's subjective considerations. In this way, consistency of judgment was established.

3.3. Data collection

3.3.1. Sampling criteria and method

A number of 20 semi-structured interviews have been conducted with interviewees deliberately selected via expert sampling. In order to collect the data for this study, non-probability sampling techniques have been used, as it was important to gather a sample with particular characteristics. Expert sampling is a type of purposive sampling where participants are chosen based on their knowledge and expertise regarding the research topic (Frey, 2018). The role of "expert" is that of somebody who has "contextual knowledge" about a topic (Bogner & Menz, 2018) and who can provide the researcher with useful and insightful information (Babbie, 2014). This type of non-probability sampling method ensures that the collected data is relevant for the research objectives. For the present study, the status of expert was granted to scholars or industry professionals that have relevant knowledge or first-hand experience regarding

applications of emerging technologies in cultural tourism, museum practice, experience design, technological innovation using XR. This includes museum specialists and professionals, as well as external experts, such as senior researchers, consultants specializing in new media and innovation, entrepreneurs and project managers in the field of XR experiences production and design, XR artists and designers, content creators, and content strategists. The diversity of backgrounds and careers of the selected experts was intentional, as the topic under investigation is multifaceted and transcends disciplinary boundaries, thus it was considered important to investigate it from multiple angles.

The sample size was regarded as sufficient to respect the saturation principle and not too large to compromise the depth of the analysis. In qualitative studies, theoretical saturation is reached when there is no new data emerging anymore and a deep analysis can be performed (Brymann, 2012; Flick, 2009). This ensures that the collected data is sufficient for the analysis and provides diverse insights into the topic (Brymann, 2012). The diversity of the experts' backgrounds and careers account for a holistic perspective regarding the topic under investigation. For this reason, even though the sample size exceeds the minimum requirement of the methodological guideline, it was considered appropriate to go beyond it in order to gain a comprehensive, more nuanced perspective. Moreover, the interviews were conducted with experts from multiple countries, a form of adding another layer of depth to the research. A complete list of the experts that participated in this study can be consulted in the Appendix A.

3.3.2. Expert Interviews

The backbone of the research design is represented by the data collection process. Primary data was gathered through conducting a series of semi-structured interviews with experts selected according to the sampling criteria laid out in the sub-section 3.3.1.

As a qualitative method for data collection, semi-structured interviews enable the researcher to collect open-ended data and to thoroughly explore the interviewee's thoughts and beliefs. The main aim behind semi-structured interviews is to obtain answers that are "spontaneous, in-depth, unique, and vivid" (Kallio et al., 2016, p. 2960). This type of interviewing strikes a balance between structured and unstructured interviews, by allowing space for flexibility while adhering to a pre-arranged set of questions that guides the conversation towards the research question of the study and ensures consistency across all interviews.

Standardization was an important criterion for ensuring the consistency of the data collection process, hence the reliability of the study (Kallio et al., 2016). For generating standardized questions, the operationalization part was highly relevant. This generated a first level of questions that were predetermined in relation to the theoretical framework. However, adjustments to the initial topic guide have been made throughout the research process. Moreover, several questions were adjusted based on the background and experience of the participants, resulting in inevitably unique dialogues. Then, for a more nuanced conversation, follow-up questions and comments were used based on the specific responses given by each participant, which maintained the conversational flow and resulted in a more dynamic dialogue. As Kallio et al. (2016) pointed out, the semi-structured interview is characterized by these two co-existing levels of questions, namely the main themes and the follow-up questions. Throughout the whole duration of each interview, the researcher multitasked, using "double attention" to ensure a rigorous interviewing process, explained by Wengraf (2001) as a way to ensure that interviewees have freedom to express their ideas, while also guaranteeing that the depth of the conversation is satisfactory for the objectives of the study.

In terms of practical matters concerning the process of collecting the data, it is worthwhile to mention that the interviews should be ideally conducted face-to-face, as this remains the "gold standard" of interviewing (Bogner & Menz, 2018, p. 15). Being a form of synchronous communication in time and place, this interactive method of communication ensures direct reaction in the form of spontaneous responses, with no extended reflection (Opdenakker, 2006). Nevertheless, research points out that the use of digital technologies as data collection tools can provide several critical advantages, replicating, complementing and optimizing traditional methods (Archibald et al., 2019; Braun et al., 2017). Video calling options through online platforms, unlike simple phone calls, enable the researcher to still gather information about non-verbal cues- helpful for getting a more nuanced interpretation of the responses- and confer better capacity to control the conversation and create rapport, similar to face-to face interviewing (Bogner & Menz, 2018; Opdenakker, 2006; Weller, 2015). For this research, in-person meetings were not always the most convenient option because of different circumstances (i.e., interviewees residing outside the Netherlands or interviewee's preference for online calls), therefore interviews were conducted mainly in digital format. The preference for online methods has been explained in the methodological literature as relating to factors such as

convenience, efficiency, cost-effectiveness, and flexibility (Archibald et al., 201; Hewson, 2008). Indeed, digital technologies facilitated the data collection process and provided help in connecting in real time with geographically dispersed interviewees. The videotelephoning platform Zoom was the researcher's preferred choice for conducting the interviews, research suggesting that its simplicity and user-friendliness are superior to other platforms' (Archibald et al., 2019). Only two interviews were conducted face-to-face, out of which one took place at the location of the Netherlands Institute for Sound & Vision in Hilversum, the media hotspot of the Netherlands.

Prior to the interviews, the interviewees had to read and fill in an Information and Consent Form or give their oral consent at the beginning of the interview. They were assured that all the data would be used only for research purposes. The interviews were recorded and subsequently transcribed verbatim, with full transcriptions stored in a separate file. As previously mentioned, follow-up questions were asked to complement the standardized questions from the interview topic guide and notes were taken during the interviews. Alongside the topic guide, note taking allows saturation of answers and, hence, proper extraction of information (Babbie, 2014). Except for one interview that was conducted in Romanian and then translated, English was used as a lingua franca yet cultural differences were permanently considered. The relationship between interviewer-interviewee was regarded as essential in the interview process, for this reason establishing rapport was a primordial task. Icebreaker questions were used in the beginning to engage the participants in an introductory conversation about their background and experience.

3.4. Operationalization

Drawing upon the literature and the conceptual framework introduced in the theoretical chapter of this paper, a topic guide was put together to turn the most relevant concepts into main themes and sub-themes. The topic guide includes a list of standardized questions structured based on the themes and sub-themes and can be consulted in Appendix B.

3.5. Data analysis

3.5.1. Thematic analysis

Regarding data analysis, Bogner and Menz (2009, p.16) acknowledge the fact that there is “no standard procedure for analyzing expert interviews”. For this study, the most appropriate method to analyze the data has been a qualitative analytic method specific to social research, namely thematic analysis. Thematic analysis as “a process for encoding qualitative information” that enables the comprehension and interpretation of data in a systematic manner (Boyatzis, 1998, p. 4). The strength of this method consists of the high degree of control when it comes to data analysis, the material being examined gradually (Kohlbacher, 2006), using coding as a tool to create order in the mass of collected data and allowing the researcher to identify and interpret recurring patterns (Joffe, 2012).

A deductive, concept-driven approach of coding and theme development was used. Deductive research is characterized by moving from general to specific (Babbie, 2014, p.22), thus the theory served as a point of departure in generating themes before the start of the analysis, as an alternative to using open coding. In line with this approach, themes and corresponding sub-themes were developed a priori based on the research question and the relevant concepts from the theory. An initial step after collecting all the data was transcribing the interviews verbatim. According to Gilbert (2008), this form of transcription is the most suitable for relatively small sample sizes specific to qualitative studies and provides help in guiding the analysis process. The thematic analysis helped disentangle the collected data and identify underlying patterns of meaning in the interview transcripts that are relevant in relation to the research purpose and the themes developed a priori. The codes generated from the theory were applied to the transcripts with the purpose to pin down meaningful segments of text. Subsequent to the process of data segmentation, the steps of reassembling and interpretation followed, allowing the collected material to be turned into findings, step-by-step, in line with Braun and Clarke’s (2006) top- down, theoretical thematic analysis framework. Most of the data could be coded according to the themes developed a priori, despite the fact that new themes were also allowed to emerge in inductive fashion.

According to methodological literature, human expertise combined with computer data processing can improve research performance (Richards and Richards, 1992; Taft, 1993). In light of this consideration, the qualitative data analysis software Atlas.ti was used in order to facilitate data management and organization, supporting the coding procedure. This computer-assisted tool is efficient for assigning the data to the core themes corresponding to the concepts derived from

the theory. The interview transcripts were entered into Atlas.ti and the process of data coding was performed on each piece of text. Similar to other programs for qualitative data analysis, Atlas.ti allows researchers to "create, display, and explore relationships between segments of coded text" (Evans, 1996, p. 272). Its use provides a high degree of transparency and replicability (Hwang, 2008). Nevertheless, the key task of interpreting the data by extracting meaning and establishing relevance from it rests on the researcher (Taft, 1993), a consideration that strengthens the fact that the use of the software has been rather complementary, than mandatory.

3.6. Research ethics

In the spirit of ethical practice, this thesis paper respected the rule of obtaining voluntary, informed, and unambiguous consent to participate in the study from the experts. As previously mentioned in section 3.3.2. about the data collection, an Information and Consent Form was sent to the research participants prior to the interviews, elaborated in line with the latest sample form available on the university website. The form included an information sheet with details regarding the research and the procedures, as well as a certificate of consent. The participants had to give their oral or written consent prior to the start of the interview and had the possibility to ask any question regarding the Form.

In terms of other ethical obligations, the research has been conducted with respect and accountability regarding other scholars' work, in agreement with good citation practice, and the results of the study were reported in a responsible way, attempting to provide a high degree of clarity and transparency.

4. RESULTS

Given the diverse backgrounds and careers of the interviewed experts, combining their insight, interpreting their perspectives comparatively, and looking for patterns was key for providing a comprehensive, well-informed response to the main research question underpinning this study, which is: *how do museums use XR technologies to innovate their visitors' experience in order to gain a strategic position?*

This chapter presents the analysis of the main findings, zooming into each of the proposed themes and reflecting back on the theoretical insights and arguments that were previously introduced in the theoretical part of the paper. The layout mirrors the one of the theoretical chapter, accounting for a structured manner of organizing the results by theme and sub-theme. In the first part, experts' perspectives on innovation are presented. Following this, the second part analyzes visitor experience design by exploring visitor engagement, visitor participation, and experience co-creation through all their corresponding sub-themes.

4.1. Innovation

As laid out in the theoretical chapter, innovation is regarded as a key aspect for the renewal of museums, responding to a new technological, social, and consumer landscape (Bakhshi and Throsby, 2010; Camarero, 2011; Eid, 2016; Vicente et al., 2012). In relation to innovation, one of the sub-questions that has been proposed for this study is: *how do museums use innovation in visitor experience to gain a strategic position?* In order to provide answers, it is important to evaluate how the experts understand the role of innovation in the museum context by zooming into how they perceive forms of technological innovation in visitor experience, what potential for strategic positioning they perceive it has, and what innovation processes they find the most promising in this sense.

The experts unanimously agree on the role of innovation and contend that innovative practices are necessary for aligning the museum mission and identity to new expectations from the visitor side. Issues related to *purpose* were highlighted by Expert 6: "you can design something and then, later, you decide it doesn't work. But you don't know why because you never discussed the why. So I think a good design project always needs a 'why'".

4.1.1. Technological innovation in visitor experience

Undisputedly, emerging technologies were considered by the interviewees a great opportunity for innovation in visitor experience. When discussing major trends and developments regarding technological innovation in the past years, the interviewees' answers revealed enthusiasm and hope for leveraging emerging technologies. In this sense, the

interviewees identified the potential of museums as places of experimentation with emerging technologies, which adds value to the visitor. According to Expert 15:

> It's the fact that in the museum world, you can often sort of explore future technologies, under constraints, or under a situation where you can afford to do things that the consumer technology in the everyday context cannot yet. But you can kind of explore the near future under the sort of almost like lab conditions, but with the purpose of not being a lab for study, but as a space for people to learn stuff, often, or have some kind of experience.

Despite critical opportunities, a lack of purpose in their adoption was also signaled as a common shortcoming. A shared concern was that technology may be used without a purposeful motivation or well-thought plan. Instances of the discourse against adopting technology just for its own sake appear in a great majority of the interviews, consistent with the technological determinism critique voiced in the literature. The matter of *agency* discussed by Dafoe (2015) came forth in the interviews. Rather aligned to a constructivist understanding of technology that relies on contextualisation, the interviewees revealed that museums should thoughtfully reflect on the real added value of technology once they decide to adopt new forms of technology in their exhibitions. In this sense, Expert 3 explained:

> I'm also the person that always says: yeah, but why do we need technology for this? I mean, it's not always necessary. So I think it's important to have a 'why' when the story is really good and the interaction can help or maybe enhance the experience, then that's really good. I mean, then I really like it. But also in a few museums that I visited, I don't know, the last five years, sometimes they're just using the interaction for the interaction or the technique for the technique. And then I'm like: yeah, I'm not really feeling it. I don't know why they do that. Is that really the best solution? All those kinds of questions.

The shared concern regarding the lack of purpose also echoes an aspect discussed in the literature, that of the "technology trap" (Šola, 1997; Arthur, 2018). According to Expert 5, "it's not only the technology, but it's what are you going to offer, what type of content design, what type of experience". Offering an artist's perspective on the matter, Expert 9 explained that "technology is not there because you need to have it, but it's just a tool, like paint". These views converge towards the conclusion of Expert 15, who asserted that: ". . . we need time to have a

critical position to new technologies in this context" in order to shift from the hype phase to the usable stage, seeing the true potential of the technology. Connect to that, Expert 10 highlights the complex nature of technological innovation: "And if you think that if you understand technology, that you understand how it communicates, then you are wrong, you are mistaken."

The *gimmickry* aspect mentioned by Marques and Costello (2018) in the literature-relating to the idea that commercial aims may deter from the true potential of innovating the experience is mentioned by Expert 12, confirming, then again, the idea that technology needs to be purposefully implemented with consideration to how it can add value to the visitor.

4.1.2. Strategic positioning through differentiation in experience

The idea of experience-based tourism and the concept of the experience economy (Pine and Gilmore 1998; 1999) from the literature resonate in the experts' responses, as many of them discuss how museums should be focusing on the experience, rather than solely on the artifacts, with visitors themselves being more experience-bound (Expert 16). Indeed, the museum experience is constructed based on many elements during the visitor journey, as Expert 13 points out:

> So, if I go to the Rijksmuseum, of course, I'm gonna see the Nightwatch, but I don't remember if I actually saw it. . . . Or a Vermeer or whatever, like, like, it's sort of interchangeable. Or the Mona Lisa at the Louvre. Like, yeah, I've seen it. But, you know, I remember the crowd. That's more than anything.

This is a view particularly intensifying in the last years, an argument supported all through the literature and confirmed by the experts. Expert 13 explained: "But the sort of sense of viewing the museum as a whole . . . entertainment-education experience was there but it wasn't as supercharged as it's become now." For this reason, differentiation in experience comes as an effective strategy, as crystallized in Expert 13's words- "putting the exhibition on isn't enough", but the museum needs to focus on how to differentiate itself in terms of the experiences it provides, how to design experiences to help visitors be inspired by those ideas" or "getting a vibe". The interviews bring to the fore topics such as *memorability* and *authenticity* when discussing museum experiences. Experts 1 and 16 also mention the idea of *transformative* experiences, hence experiences that have a strong power and influence on the visitor. Expert 13 also introduced the idea of exposing the visitors to new things and challenging their perception, which aligns to Expert's 12 idea of going "outside the box". This pattern across interviews is

consistent with claims made in the literature that museums are becoming more and more important in the experience economy and hence there is a great opportunity in gaining a strategic position through differentiating based on experience (Porter, 2006).

Another element that was mentioned in relation to strategic positioning was *branding* (Expert 13). As explained by Expert 13, the strategic approach undertaken by museums should be in perfect alignment with the museum mission and brand, hence experiences need to be tailored around the identity that the museum seeks to build.

4.2. Visitor engagement

This section is aimed at addressing the sub-question: *how do museums use XR technologies to engage the visitor?* As previously explained in the theoretical chapter, the literature recognized the clear role that visitor engagement has for the innovation of the visitor experience, as it related to processes of meaning-making in which the visitors use the museum context to create images of themselves (Edmonds et al., 2006; Taheri et al., 2014; Welsh 2005). In relation to this, the potential of XR technologies to enhance the level of engagement was also highlighted (Han et al., 2018; Tom Dieck and Han, 2022 Trunfio & Campana, 2020; Trunfio et al., 2022). "it should always enable us to do whatever we want to do and tell the stories and engage the people however, we want them to engage" (Expert 2)

4.2.1. Storytelling

What came out of the interviews as an important finding regarding visitor engagement is that technology should fuse with the story for a successful effect (Expert 3). A memorable museum experience starts with an impactful story. The respondents explain, without exception, the importance of the story for visitor experience design. Expert 9 revealed that for her "the story is leading". Building up on the same idea, Expert 8 explains: "I think it can't be underestimated how important that [the story] is, because that's the backbone that you can base the interaction on. It's where you make the interaction meaningful or not." The story "is really what is primary, before you design, the interaction" and has to be contextual and educational, giving "meaning to the actions that a user performs". The perspectives shared by the interviewees align to theoretical insights that place stories at a foundational level in experience design processes and explain the importance of delivering narratives. Aligned to this, Expert 18 explained:

> The first thing that one should think about when you want to design an experience is the story. So, the story comes first. And then once you have the story, you can also think: okay, what is the means, what kind of technology can we use to bring these stories across? And not the other way around . . . you need to see- does that technology fit with the story that we want to tell?

Discussing strategies for developing impactful stories, Expert 6 introduced the idea of *multi-layered storytelling*, made up of a " a core story that everybody can grasp" but also "some hidden gems, jokes and references to art that not everybody gets (...) multi-layered for people that want to know more or people that have more time", reminding of a "good Hollywood movie". A critical consideration, though, is that "the core story should inspire in a fiery, very direct way". In connection to this idea, Expert 9 stressed the importance of providing a story that is *inclusive* and *universal*, explaining the meaning behind using the 'kaleidoscope' in her immersive digital art exhibition as a metaphor for challenging society's role models and offering a more inclusive, relatable perspective: "So, I think that's the place where I want to be- like this universal, day-dreaming, collective kind of energy". However, while the core should be universal and easily accessed, stories should be open to interpretation and give a "push for a lot of thoughts and a lot of discussions". This balancing act between a universal, inclusive story and providing an open space for interpretation constitutes a possibility for relatability and accessibility in terms of content design. In delivering stories, "museums have . . . a need to be more accessible, and more representative of the cultural diversity of their communities" (Expert 13), about making "people feel safe and included." When delivering the message, the story needs to be "as wide as possible, as broad as needed" (Expert 7). This echoes arguments of Shehade and Stylianou-Lambert (2020), who claimed that VR applications opened up many possibilities for experimentation, based on the premises of openness, freedom of interpretation, accessibility, inclusion, and democratization. Expert 16 "how different communities can see themselves"

. So it's about understanding how can we make it accessible to more audiences and inclusive make, you know, make the whole museum feel that everyone is welcome and there's something here for all (16)

Another important aspect in relation to storytelling is the idea of concept testing. Expert 6 revealed that this aspect is crucial, alongside experience and talent - “So when we have stories, we try them out and see in which way they inspire”. Expert 9 pointed out that impactful stories are backed by research and science. To give a glimpse into her perspective on combining art and science when designing the right story behind an exhibition, Expert 9 added: “I studied a lot with (...) how does your brain work? How do we conceive image? Like, how does it travel from your eyes, from your retina to your brain? And like, what makes it happen?”

The points laid out in this section converge to the idea that the story should be the driving force in experience design. Content is key and storytelling should precede the technology application and not the other way around, as technology by itself cannot tell a story. Summarized in Expert’s 3 words: “the technique is nice, but it also has to tell something”. This connects back to the idea of the “technology trap” (Šola, 1997; Arthur, 2018), where technology is used just for its novelty and availability. To avoid this, well-thought storytelling should always guide the application of technology in a holistic, integrative direction, and museum professionals should use content design as a method to filter whether technology truly adds value to an exhibition and can support the story in a meaningful way.

When matched with the story, technology can provide immense opportunities. Some of the interviewees stressed that XR technologies can be effectively employed for interactive storytelling or can tell a story that would not be possible without the facilitation of the technology by augmenting or complementing the story. Several experts pointed out the fact that stories can go beyond the museum visit itself, form in the pre-visit phase and be experienced after the museum visit has ended, as explained by Expert 6. In relation to this, the potential of XR in developing the stories has been highlighted across many interviews.

It's full spectrum is one of those areas that promises spatial storytelling, which museums are about, new ways of interacting (expert 15)

the human communication, and therefore the story that you tell whether through the real time, live human interaction, or maybe some aspects of mediation, that's where the power lies.” (15)

4.2.2. Immersion

The experts share similar notions about immersion and stress the goal to use techniques that are effective in immersing the visitor in the exhibition. Contributing to immersive experiences in both the museum's physical and virtual space is the feeling of *presence*, of "being there", introduced in the literature (Bartlem, 2005; Ermi and Mäyrä, 2011; Lombard and Ditton, 1997; Parker and Saker, 2020; Slater, 2003). This is a fact confirmed by many interviewees, which validates a theoretical discussion on the role of presence in visitor experience design (Jung et al., 2016; Gilbert, 2002; Popoli and Derda, 2021). Museums use immersion to engage the visitor through all senses and to create this feeling of presence, as well as of submersion in the exhibition context. Through this form of experience enhancement, the visitors are able to engage with the exhibition more closely. Experts pointed out that immersive exhibitions are not reliant on technology, but rather assisted by it, a finding that is in accordance with academic arguments that immersion does not implicitly mean the use of digital technologies (Bartlem, 2005).

The experts argue that XR technologies can help design immersive exhibitions that surround the visitor, offering the perception that he is immersed and transported to a place and time. Contributing to immersive experiences is the feeling of *presence* in the space of the exhibition. Discussing a future artistic project using immersive technologies, Expert 9 highlighted the power of transporting the visitor to a different place:

> Now we want to make a room with raindrops. Because moving water- here [in the Netherlands] we have a bit. It's like a place that people like to settle, you know, like they like to settle next to creatures, they like to settle next to a river. They like to go to the sea because the moving water makes them feel like they can put their worries away, they can empty their brain.

The impression of *non-mediation* is in strong relation to immersiveness. Expert 12 explains that a goal in the exhibition design process is "making the technology hardware the least visible. So we that the visitor uses his body, his own personal body, to engage with content. And not with an extra tool or an extra screen or an extra thing." To achieve this effect of non-

mediation, seamless integration of the technology is crucial, many respondents reveal. The idea of *seamlessness* needs to be understood as a design where the technology is "invisible" (Expert 12, 14, 18), "hidden", belonging unnoticeably to an overall elegant design (Expert 6), as "the visitors don't have to know the technology is there" (Expert 12). The interviewee's accounts align with the argument of Margetis et al. (2020) that seamless integration enhances immersion and blurs obvious boundaries between the real and the virtual. To substantiate this argument, Expert's 6 explanation about seamless and elegant design is useful:

> I've been a lot to the VR conferences, every year in Amsterdam, because we like the technology. But if you go there, it's like going to the media markets almost, you know, it's full of plastic equipment and cables. And if you say: oh, I would like to try it, you sit there and we put it on our head and we have to adjust it. And . . . it's like you go on a mission to Mars. And you would like it to be the opposite, to just move through the space and all of a sudden be surrounded by the 17th century Amsterdam harbor or by a future vision or whatever beautiful story you would like to tell. So . . . that's the elegance.

Another point that supports the idea of seamless integration is that without it the exhibition risks to look quickly outdated, as technology advances at a fast pace and museums cannot reflect these changes at the same pace. Expert 6 explains that the success of immersive exhibitions such as the one at the Heineken Experience museum relies in hiding the technology, stating that "if you make something that is interesting for a few years, if the technology is too visible, it gets outdated."

Out of the two XR technologies discussed, VR was particularly highlighted as having immense potential to immerse the visitor, Expert 11 highlighting the potential to make virtual environments seem like real life places.

4.2.3. Emotional engagement

Emotional engagement was an aspect that was reiterated throughout the interviews as an important criteria for well-designed XR experiences in the museum. This falls into line with scholars' ideas that emotion is a source for authentic, meaningful museum experiences (Greppi, 2021; Sani, 2021).

The three elements underpinning emotional engagement highlighted by Li et al.(2014) were identified in the experts' responses. Accordingly, the subjective experience, the expressive element, and the psychological arousal were referred to, in a form or another, by many of the experts. Expert 11 mentions having the "right emotional triggers" as an important part in the experience design and, according to expert 19, "people that develop new applications using AR/VR need to be also psychologists because the application needs to . . . create emotion in people.

Substantiating the role of XR in delivering emotional experiences by providing closer connections to the exhibition space and artifacts, experts discuss that emotion is a critical condition for the overall visitor experience, a pattern that supports the literature (Greppi, 2021; Mazzanti, 2021; Sani 2021).

4.2.4. Cognitive engagement

Along with emotional engagement, the concept of cognitive engagement represents a central element in XR experience design, as AR and VR applications can be a form to engage the visitor by transferring knowledge and providing opportunities for active learning, experts agree. This view aligns with scholars' ideas on the role of educational and learning experiences in the museum context (Bartlem, 2005; Pekarik, 1999). Expert 5 stresses the fact that "it's not just preserving the piece of art, it's also transferring the knowledge. The interviewees exemplified how XR experiences can augment knowledge and add supplementary layers of information, offering best practices from different museums which successfully implemented AR/VR innovations by capitalizing on the learning/ educational properties, founded on knowledge-transfer. Expert 4 explained that innovations such as AR apps represent an addition to the museum experience and not a replacement, augmenting the knowledge of the visitor in a way that is engaging and stimulating. Moreover, AR can provide extra layers of information, as in the example of art museums that display paintings with multiple layers one on top of the other, that can be dissociated with the use of AR.

In order to avoid limitations related to cognitive engagement, referred to in the literature as "overtax of cognitive resources" (Geroimenko, 2021, p. 14), visitor fatigue (Marques and Costello, 2018) or user cognitive overload (Ko et al., 2013), experts pointed out that the visitor experience should be designed in a way that leaves space to control the knowledge transfer, so

that the visitor does not feel overwhelmed throughout the visit. In this sense, Expert 3 explained: "it's important to have those passive moments and interactive moments in the whole experience, because that's a nice flow (Expert 3).

if you embrace the idea that museum is transferring knowledge, then it will take the experience of the museum to another level." (5)

people found that it was overall an enjoyable experience, because they left, you know, understanding more, they got to be part of it and really appreciate it in a new way (Expert 16)

the most proven aspect of virtual reality is in the educational format. So that for sure is a good way to, to use virtual reality

4.3. Visitor participation

As previously explained in the theoretical chapter, the literature recognized the clear role that visitor participation has for the innovation of the visitor experience (Antón et al., 2018; (Campos et al., 2015). Several sub-themes of visitor participation that were derived from the theory will be addressed in this section of the analysis, aimed at answering the following sub-question: *how do museums use XR technologies to stimulate visitor participation?* Drawing on seminal contributions such as Simon (2010), Falk's (2009) or Falk and Dierking (..., the idea of the "participatory museum" based on dialogical relationships between the museum and the visitor identity through forms of active participation has become well established in academia. The potential of XR to stimulate visitor participation has been supported by the experts' claims, who agree on the opportunities of AR and VR to turn the visitors from passive observers into active participants. The idea of "*being* there instead of *seeing* there would be this feature" (Expert 15), where "designing the experience for participation" becomes key (Expert 13).

if you want to make a change in the world, you obviously need participation, because any type of political change or social social change, needs people participating in it for it to be, you know,

equitable, just democratic, democratic, whatever, will just to happen, actually, so they takes the sort of, should it be participatory, or not out of the question, because obviously, it has to be participatory, because otherwise it's not going to work. (13)

4.3.1. Interactivity

To all experts, interactivity is a core issue in visitor experience design. This is exemplified in claims such as "a more interactive experience- that's the essence of our company. So we believe in it" (Expert, 6).

Expert 8 encourages". . . thinking about an interesting interaction that you can offer to the users that makes them really engaged with the objects instead of just observing the objects and handling the object, when you are able to design an interesting interaction around it" . Aligned to this line of thinking, Expert 9 questioned the traditional, conventional museum exhibitions, posing questions such as "why do we have to stand still and not be able to touch anything, and be like a distanced viewer?" signaling that "every time we hear from somebody who's watching the room . . . like you're not allowed to touch, you're not allowed to crawl, you have to be like this, you have to be like that" museums "take away the purity of discovering". This links back to the *sense of discovery* underlined by Ciolfi and Bannon (2002) who asserted that the traditional "rules" of behavior in a museum have to be suspended in order to stimulate interactivity and let the visitor participate. In line with this, Expert 11 reflected on several similar questions, wondering about challenging traditional experiences inside the museum and brings forth new forms of interactivity, founded on freedom of choice: "what about if we turn upside down the museum? . . . What about doing things that you are not supposed to be able to do in the museum? . . . It's, it's, it's breaking the rules"

When it comes to how to design interactive experiences, Expert 8 recommends that interactivity should be based on contextualization and storytelling, hence relating to a form of visitor engagement previously discussed: "the story is really what is primary, before you design, the interaction" and "before you decide what kind of interactions will there be with the virtual content, with the surroundings, etc."

The aspect of *tactility* was touched upon by several interviewees. Expert 10 observed that "human touch . . . something which is still very underestimated, I think, within the technology."

you can touch something- tactility (Expert 16). Similar ideas are shared by Expert 12: “because we want things to be tactile, you want things to be touchable and not screens as much as possible.

The BYOD model discussed in the literature (Roussou and Katifori, 2018) is also mentioned by some experts, with a reflection on both possibilities and drawbacks. Interesting insights are laid out by expert 12:

> So what I do like is that people bring their own device, so their own phones. But it's, the downside is people are constantly, constantly looking at their own phone, busy with the phone. And actually, we want them to be busy with the space and with other visitors. And the most important interactive element we use is people. So we really like to make exhibitions where visitors or people that work in a museum, become part of the exhibition and really control the experience. So then again, you can also use augmented reality because they can have the tools and they can play with it.

Another aspect that refers to the BYOD model is that people do not download apps (Expert 17), as this produces “skeletons” on users’ devices (Expert 2), as there is no benefit of the app after the museum visit. In this way, AR apps that would work as a platform to connect multiple museums can be an opportunity to capitalize on.

The potential of XR technologies to offer interactive experiences was agreed upon by many of the respondents. Regarding this, Expert 8 explained:

> I think, because you're working with virtual elements, say a certain artifact that is in the collection of the museum, it allows for getting rid of the taboo that these artifacts are precious and can't be engaged with actively by users. So it allows for putting these virtual objects into the physical hands of the visitors without the conservators getting really anxious about that. So it lowers . . the barriers, it makes the objects themselves more accessible to the visitors, to the users.

Simplicity and *intuitivity* in design is another interesting point that was reflected in the interviews. In this sense, Expert 12 explains:

or the visitor, the interactivity should be really simple and understandable. And they might have no idea that there's quite some high tech going on, as long as the interaction between you and the media is poetic, as we say. So, it's a very nice, poetic gesture that you're doing.And, maybe this thing that we do now with fancy technology we already did it with low tech 10 years ago. And the idea stays the same, but now it's just nicer and it's better, it works better. But for the visitor it doesn't really make a difference as long as the metaphor you're trying to do is the same.

4.3.2. Game design

In the literature, a multitude of terminologies are proposed for game/play elements. Here, game design is proposed as the current term for the introduction of game elements in the visitor experience design. This term is preferred to gamification, Expert 2 echoing scholars' concern that the term may have negative connotations (Deterding et al., 2011). Experts 11 and 12 proposes the use of "play".

Games should be well-thought and properly contextualized. If they are "a way to capture audience's attention and keep them busy with something, where the longer time is better, than . . . it's ill-informed", asserted Expert 15. To ensure proper design, the games should be contextualized in relation to the visitors. Expert 7 confirms Ermi & Mäyrä's (2005) argument that the player has a central role in the game experience. Accordingly, game design is effective as it makes "the visitor part of the experience" and lets them the freedom to choose.

Experts believe that there is huge potential in combining XR with game design in order to stimulate visitor participation. Important for creating playful participation are the elements of "creative and transgressive play", an argument consistent across the literature (Back et al., 2018; Nicholson, 2012) and the interviews, to explore on their own terms, guided by intrinsic motivations.

"There's a big job to explain the power of gaming, the power of games, and also the big job that is behind designing a game experience", as underlined by Expert 11. Expert 7 pushes for a definition of game as a cultural product that can deliver messages. Several experts reflected that game elements are still widely perceived as something not too serious, a "tool just for kids". To avoid that, expert 11 asserted that "And one thing that I think is very important is that we want museums and exhibits to be suitable for children, but not childish. This is also a very

important thing . . . then it becomes childish or it's Disney. The concept of Disneyfication has been revisited in the literature (Kotler & Kotler, 2000).

Expert 11 discusses combining the physical and virtual experiences in game design In relation to this, he referred to the concept of the "magic circle" introduced in the literature (Huizinga, 1938) by stating that"what's happening is called the magic circle. It's when, when you play a game, and you're there, and there is nothing else, and you lost, lost the sense of time."

4.3.3. Personalization

While many experts deemed personalization as an important trend in museum experience design, some pointed out the fact that it is difficult to implement, with several ones who were rather hesitant about the true added value. In this sense, Expert 6 challenged the role of personalization in the museum context, claiming that "maybe a museum experience is sometimes escaping . . . personalisation". When it comes to personalization for the on-site experience, from the implementation side it poses several challenges and "oftentimes, the technical extra hassle to create this kind of personalization is not worth it".

Freedom of choice is correlated to personalization in most cases:"You definitely want to feel inspired, taken seriously, and also have in that respect a bit of a personal experience that has urgency for you. Not just people telling you this is important, you have to like it". Expert 6 discusses possibilities for personalization rather in the virtual, home experience format, pointing out that personalized experiences can detract from the social element of the museum visit. To avoid that, the museum should strike a balance between personalization and the social experience (Expert 6).

When it comes to using technology for personalization, several experts point towards artificial intelligence as a better alternative for tailoring the experience to the visitor and delivering a personalized meaningful experience.

Expert 8 proposed the "personalized content-based approach" which, depending on certain characteristics of the visitor, generates different content within the visitor experience. This ties to the idea of *diversification* of content that is "presented within the predefined experiences that people can have within the museum".

4.3.4. Social interaction

XR experiences were discussed in the literature in relation to the concept of *sociality*, more specifically how XR technologies impact the social experience of museums (Duguleană et al., 2019; Parker and Saker, 2020), a topic that was also interesting to explore in the interviews, as a vast majority of the interviewees highlighted that museums are, essentially, social spaces, hence the visitor experience depends on forms of social interaction. This is best captured in Expert 6 words: "we think, for museums, you always want the social experience." Social interactions can be classified as organic/undesigned or by design (Expert 8). Technology can facilitate the creation of the latter ones, by providing opportunities for social connectivity, as it is the case with interactive installations that are meant to be enjoyed with multiple users or apps that "challenge people to meet at a certain place in the museum to have an interaction, maybe even discuss some of the content of the museum" (Expert 8). As a general observation, social interaction should be made easy (Expert 10).

The *open-ended* character of interactivity is highlighted by the respondents, defined by Expert 8 as:

> . . . allowing for means to freely explore larger parts of the collection of a museum, to also do that together with other visitors, and not being stuck so much to what is often a linear or a tree interaction, but really building in some open-endedness, into the extended experience.

Reflecting on XR possibilities, Expert 8 adds more to that point by arguing that it ". . . would really be an interesting concept for people to really freely explore not only the physical space, but also whatever can be augmented, and extended. . . . not being tied to one or a couple of predefined narratives."

A pattern that emerged from the interviews is that VR, generally, can negatively impact the social experience in the museum. In this sense, Expert 6 believes that VR still has limitations "because it is quite, let's say, individual . . . almost . . . an autistic experience." Adding to that, he claims that ". . . when you've traveled to a place with friends and then you put a device on your head that that gets you away from the place and away from your friends- then, that's illogical, and actually probably counterproductive". Expert 12 shares a similar view: "we kind of stay away from VR . . ., because it's an enclosed experience. It's not a social experience that much". However, VR has potential for social interaction, and that would be to combine the VR enclosed

experience with an experience in the physical place (Expert 12). Some experts underlined that from the point of view of the social experience, AR has better applicability as it maintains a stronger connection to the physical space and hence provides more opportunity for social interaction between the visitors and staying socially engaged.

By contrast, Expert 17 believes that VR does not pose limitations to the social experience of the museum, but can actually enhance it. Expert 13 supports that claim, discussing the "visitor chemistry" that forms between visitors during the on-site experience, but something that can be translated also in the virtual space.

4.4. Visitor co-creation

Lastly, this section of the Results chapter seeks to explore the sub-question: *how do museums use XR technologies to co-create experiences together with the visitor?* When conceptualizing technology enhanced museum experiences, the theme of co-creation emerged as a critical one, with scholars who underline that this form of letting the visitor co-create is a fundamental way towards experience innovation

In the context of museums, experts share similar notions about co-creation, agreeing on the importance of finding ways to create together with the visitors. Expert 9 elaborates on that, by referring to the paradigmatic shift towards visitor orientation addressed in the literature:

> . . . it's a little bit different from, of course, the times of Picasso, when he had a great idea about himself, and he wanted to transform his mental state to the viewer. As for now, I think . . . it's more about, like, how can we do this together?

4.4.1. Pre-visit phase: virtual experience co-creation

Experts 3 and 8 suggested that based on their experience, the pre-experience is not something that a lot of people make use of, therefore it is less relevant in the overall experience co-creation. By contrast, other experts identified several major opportunities that arise from introducing XR in the pre-experience phase. A case in point is using games, as they "work very well as a pre-visit", so, before the visit, the player is able to have a clue of what he can find in the in the museum or in the theater.

4.4.2. On-site phase: virtual and physical experience co-creation

Discussing on-site experiences, Expert 8 praises the "sweet spot between interaction. physical presence, and digital augmentation" as a powerful value proposition for a museum. The free choice is an important element highlighted here.

4.4.3. Post-visit phase: virtual experience co-creation after the visit

The potential of the post-experience has been acknowledged by many of the experts, who consider that the visitors' active role in the experience should "extend beyond the time they're in the museum" (Expert 13). Indeed, the visitor understands that the museum visit ". . . is not just a one-shot relation. It has to be cured, managed".

5. DISCUSSION AND CONCLUSION

The goal of this study was to gain an insightful understanding about integrating XR technologies in order to innovate the museum visitor experience and how this can serve as a strategic opportunity for museums. More specifically, by using a qualitative approach and combining relevant theoretical knowledge with data gathered from expert interviews, this Master's thesis sought to address a topic of scientific and societal relevance, underpinned by one central research question: *How do museums use XR technologies to innovate their visitors' experience in order to gain a strategic position?*

As argued throughout this paper, the main challenge that museums are facing nowadays is offering visitors unique and memorable experiences. If they manage to do so successfully, they

might achieve a sustained strategic position as they differentiate themselves via the experience they provide. Scholars have long been arguing that in contemporary times, museums are no longer preservers of collections, but enablers of new forms of dialogue with their visitors. The new museology paradigm is all about placing the visitor in the center of the museum world (Falk, 2009; Falk and Dierking, 1992, 2016; Hooper-Greeenhill, 1994; Vergo, 1989; Weil, 1990) and the visitor experience at the heart of strategic thinking (Porter, 2006). Technological innovation can support the visitor orientation of the museums, hence new forms of technology can be integrated successfully in visitor-oriented models. In this realm, XR appears as a radical opportunity, as it challenges old forms of interaction and alternate ways of experiencing the surroundings (Trunfio et al., 2022), proposing entirely different perspectives about notions of space, time, and human-technology relations. XR technologies started to be incorporated more and more in tourism and creative industries, which should be a stimulus for more academic inquiry on the topic. Zooming into museums, how XR technologies can be properly integrated to innovate the visitor experience has remained an underexplored field. This scarcity in research clearly warrants deeper exploration, hence the motivation behind a qualitative study like this one. This paper aligns to other similar academic studies published in the last couple of years, which seek to fill up the existing gaps in research and simultaneously expand the understanding of the societal relevance of the phenomenon. These studies were essential in tracking down relevant themes.

For a good overview, the findings previously analyzed in the Results chapter deserve a concluding discussion. In this sense, the most important outcomes are reviewed in this chapter, together with an explanation on the theoretical implications of the study. As the findings of this research have to be seen in light of possible shortcomings, several limitations will be presented next. Subsequently, the societal relevance of the study is clarified, including several brief practical recommendations. The last part of this chapter reflects on possibilities for future research and delineates new directions for those interested in the multifaceted process of innovating museum visitor experiences by leveraging emerging technologies such as XR.

5.1. Key findings and theoretical implications

The purpose of this section is to highlight and interpret the most relevant findings from the Result chapter and reflect on key theoretical implications of the study.

The findings also reveal that VR and AR have different affordances in the realm of museums. In this sense, the respondents expressed preference for one of the two

"Most of what we do is augmented, we always had faith in augmented being stronger than virtual reality" (Expert 10)

5.2. Limitations

In spite of adhering to reliability and validity principles, this study has several weaknesses that warrant attention. Next in this section, certain limitations which necessitate further exploration and encourage supplementary research are briefly introduced.

5.2.1. Limitations in data collection

The data collection process presented sample selection biases, most notably a regional bias. Regional differences can play a detrimental role in the way this topic is understood and addressed, based on one hand on the different characteristics of stakeholders present in an area, as well as on the degree of technological advancements or the cultural policy that affects innovation practices in a particular country or region (Vicente et al., 2012). Because of the fact that this study was not intended to provide regional- or country-specific insights, its findings may not be universally valid. Regardless of the fact that experts who reside and work in multiple countries were interviewed- many of whom have international backgrounds or have been involved in projects in various countries across the globe- it is important to point out that the views expressed are to a great extent European-specific, particularly Dutch-specific (the majority of the experts interviewed live and work in the Netherlands).

Having experts with diverse backgrounds and expertise posed a certain difficulty for ensuring perfect consistency across the interviews and sticking to the topic guide in the same manner. As some interviewees were more knowledgeable about a particular dimension of the problem, the conversations were disproportionately timed with regards to the topic guide questions. At times, the conversations were very dense regarding particular themes or sub-themes, yet less ample when it comes to others. This was an expected consequence that the researcher was aware of since the moment of composing the sample, but considered that it is still

important to ensure the diversity of backgrounds when selecting the participants and to let them take slightly more time on some questions in order to substantiate on the topics that they are more knowledgeable about. The flexible nature of the semi-structured interviews supported this approach.

5.2.2. Limitations in data analysis

When it comes to the data analysis, the deductive theory-driven approach presents a limitation for the depth of the study. Considering that the literature on XR technologies used in innovating the museum visitor experience is not abundant yet, the themes that emerged from the theory may not have been exhaustive enough to support an all-encompassing analysis. Given the degree of relative novelty of these applications in museums, an inductive, data-driven approach might have provided an added layer of nuance and flexibility in exploring the topic without an a priori set of themes. Even though new themes were allowed to emerge during the analysis process, it is important to recognise that the a priori set of themes served as main guidance.

5.2.3. Other limitations

One last limitation outlined in this section relates to the fact that museums present big differences based on their type, funding structure, management, mission, brand, and goals. Importantly, big differences in their approach to innovation, visitor experience, and technology can be observed between art museums, history museums, science museums, children museums, museums deemed as “experience-based”, etc. Several experts underlined the fact that it is challenging to explore the proposed topic unless narrowing it down and considering museums’ particularities. This study explores museums regardless of any specific variables, which may constitute a drawback in the process of analytic generalization, which relates to the ability to provide some sort of wider validity and replicability of the findings, despite the qualitative nature of the conducted research. Some findings may be more representative for a type of museum and less relevant for others. This is an important consideration to keep in mind. However, as focusing on museum particularities was beyond the scope of the present study, the researcher tried to distill those insights that present a higher degree of universality.

5.3. Societal relevance

[ICOM] definition on museums and society

Museums change people's lives

No sector is immune to disruption and what has been observed is an increasing interest among museums to adopt an innovative frame of mind. This is predictable, considering the intense competition for the consumer's time in the context of the experience economy. The center of gravity for museums of the future should be on the visitor

The museum should enable meaning between the visitor and the space- be it real or virtual- and the exhibition.

The museum experience is a multilayered

5.4. Future research

As underlined in the introduction of this paper, the topic of XR technologies implemented by museums to innovate the visitor experience and, in effect, offer strategic positioning is an underexplored field. This paper was aimed at contributing to this discussion, which has gotten more and more intense in the last few years. Nevertheless, this paper constitutes only another building block, holding up hope that it will stimulate curiosity and interest for future inquiry. Further study of the phenomenon is encouraged to overcome limitations, fill up the gaps in literature, and expand the existing knowledge.

Elaborating on the limitations laid out in section 5.2., several directions for future research can be delineated. Firstly, future research can take a more focused approach, either by zooming into national or regional specificities or by narrowing down the research on a particular museum type. Moreover, the research questions should be applied to specific museums using a case study approach, which can test how they appear in a particular context and lead to more insightful and rich conclusions. Previous studies that have used a case study method demonstrate a high ability to obtain findings that are properly contextualized (e.g., Coblence and Sabatier, 2014; Jung *et al.*, 2017; Passebois-Ducros, 2019; Recupero et al., 2019; Trunfio et al., 2018; Trunfio et al., 2020). Secondly, if the same method is to be applied (i.e., expert interviews), it is recommended to consider a sample that is more geographically-diverse or, to the contrary,

country-specific. In both cases, these would strengthen the validity of the findings. Thirdly, other variables that affect the implementation of XR technologies to innovate visitor experience should be considered in future analysis, especially the type of funding, the management structure, and the level of cooperation with stakeholders. By taking a managerial approach, a more thorough understanding of strategic differentiation can be advanced, as well as understanding on how XR applications can be implemented and monetized. Another key aspect that warrants attention for future research is visitor behavior. Studies that assess the visitors' perception and user satisfaction regarding XR technologies implemented in museums could contribute to better understanding of how the overall experience can be enhanced. These may include both qualitative or quantitative studies directed at evaluating visitors' opinion. One last aspect that needs to be mentioned is that technology advances at a fast pace, and studies focusing on technological innovation risk becoming outdated very quickly. For this reason, constant revisiting of the topic is necessary, with reflection on new affordances, as well as other emerging technologies innovations that gain prominence in the technological landscape.

APPENDICES

Appendix A- List of Experts

	Expert name and date of interview	**Expert's experience and relevance**
1.	**Dalila Cataldi** 15/05/2022	Sales and Marketing Associate at Artivive, a Viennese tech start-up that offers an AR platform for art and provides an app for museums to

		enhance the visitor experience. Other relevant experience includes previous work on interactive presentations for the LAM Museum in Lisse and collaborations with various renowned museums in Austria and the Netherlands. Her experience and knowledge account for an insightful understanding of how art is delivered and consumed.
2.	**Jessika Weber-Sabil** 17/05/2022	Senior researcher at the Faculty of Digital Entertainment under the professorship of Applied Games, Innovation and Society at Breda University of Applied Sciences, where she conducts research on games with the focus on tourism systems and experience design. Her research explores AR games for experience enhancement. She has a solid comprehension of new technology applications in the tourism sector and her expertise is helpful in uncovering issues about immersive experiences, game design, and AR applications in the museum setting.
3.	**Karen Drost** 18/05/2022	Interactive Museum Presentations Expert at The Netherlands Institute for Sound & Vision, responsible for concept development and creative lead in interactive presentations. With a background in museums and advertising and ample experience with large exhibitions, Mrs. Drost is interested in cutting edge technologies and telling stories using three-dimensional forms and technological developments. Currently, she is involved in the renewal process of the Media Museum in Hilversum.
4.	**Sergiu Ardelean** 20/05/2022	Co-founder and CEO of Vienna-based tech startup Artivive, with 15 years of experience in AR. Mr. Ardealean has a holistic understanding of AR and user experience, as well as a strong connection to the museum sector gained through a great number of collaborations. Some examples of past projects include the Living Image programme in partnership with mumok Vienna or implementation of AR technologies to the exhibitions of Belvedere Museum and Albertina Museum in Vienna. Internationally, he has established collaborations

		with the Shanghai Himalayas Museum, the Ying Art Center in Shanghai, MIT – Massachusetts Institute of Technology, the Ilmin Museum of Art in Seoul, and the Leica Gallery in Singapore.
5.	**Serena Ferrari** 22/05/2022	Digital Event Strategist, involved in digital solutions and highly creative multimedia events. Solid experience in the field of AR for events and exhibitions, applying innovative strategies and overseeing AR visitor experience. Her portfolio includes previous work for the multimedia production company Son et Lumiere, where she produced immersive experiences and interactive installations for museums and public bodies in Italy.
6.	**Peter Slavenburg** 25/05/2022	Co-founder and CEO NorthernLight, a prolific Amsterdam-based creative agency that designs transformative experiences for public spaces and museums since 1997, with a strong focus on the synergy between physical and digital experiences. Mr. Slavenburg has ample experience in the world of museums, with over 50 projects managed worldwide as Project Leader and Creative Director. His well-rounded vision contributes greatly to understanding the links between technology and visitor experience. Experience-based projects of NorthernLight in the museum sector include clients such as the Rijksmuseum, Heineken Experience, NEMO Science Center, Tate Museums, Storyworld.
7.	**Mirko Marchitelli** 27/05/2022	Project Manager at TuoMuseo, an Italian cultural association dedicated to new forms of media and innovation in the cultural sector. Mr. Marchitelli has a comprehensive understanding of game design and AR/VR applications in the Italian museum sector. A highlight of the portfolio of TuoMuseo is a 2017 project for developing a mobile game for the MANN Museum in Naples, a successful experiment that was

		the pioneer of its kind for a national museum.
8.	**Maarten Brinkerink** 30/05/2022	Knowledge and Innovation Consultant for The Netherlands Institute for Sound & Vision, offering advice on information technology and the institute's digital portfolio of products and services. This concerns both the application of information technology and the impact of new media and digital culture on the strategy and policy of Sound & Vision. Mr. Brinkerink is an expert in digital culture and information processing with over 13 years of experience in the cultural heritage sector.
9.	**Irma de Vries** 31/05/2022	Visual artist based in Amsterdam. She creates digital immersive art exhibitions, spaces, artworks and experiences with the use of AR, videomapping, sculpture, computer animation, painting, and digital techniques. Together with Moco Museum Amsterdam, she launched a pioneering AR immersive digital art exhibition “Reflecting Forward” by Studio Irma X Moco and two AR apps: “Moco Play” and “Moco Outside”. The artist’s approach reveals many layers of complexity about how science and art come together in the museum setting.
10.	**Cristian Vorstius Kruijff** 1/06/2022	Spatial Designer and consultant on emerging media and technology. Co-owner of Artishock Productions, A Dutch creative and technical agency exploring AR and VR and other emerging technologies to provide cutting-edge solutions to a wide variety of clients. Notable projects in the museum sector include the “Elisabeth and the Flood”in the Dordrechts Museum and “Panorama Rotterdam” for the Mariniersmuseum.
11.	**Xavi Socías** 2/06/2022	Gamification Advisor based in Spain. Experienced in storytelling and game design for touristic destinations. Relevant professional experience includes current participation in the international MED GAIMS ENI project, which focuses on strategies for implementing

		gamification in multiple tourism sites across four countries, including two museums in Spain.
12.	**Michel de Vaan** 3/06/2022	Project Leader and Senior Exhibition Designer at Kosmanndejong, an award-winning Amsterdam-based design agency that focuses on exhibitions for public spaces, with an ample portfolio of collaborations with museums. Previously held the position of Exhibition Designer at NorthernLight. With over 20 years of experience in exhibition design, Mr. de Vaan is focused on innovating the way in which visitors interact with exhibits.
13.	**Seb Chan** 6/06/2022	Chief Experience Officer at the Australian Center for the Moving Image where he is responsible for a holistic, multi-channel, visitor-centered design strategy for the institution. Former Head of Digital, Social & Emerging Technologies at the Powerhouse Museum in Sydney. He has also worked as a cultural sector consultant with organizations across the world and research projects in the performing arts and heritage sectors.
14.	**Marc Tamschick** 7/06/2022	Founder, CEO and Creative Lead of TAMSCHICK MEDIA+SPACE, a prominent Berlin-based creative agency for immersive narrative spaces and installations using new technologies, with an ample portfolio consisting of internationally acclaimed projects for museums and exhibitions. His +20 years of experience are centered on creation, design, and artistic production of spatial media productions, accounting for a solid expertise and know-how regarding technological innovation in the museum sector.
15.	**Jussi Ängeslevä** 8/06/2022	Vice Creative Director of Berlin-based ART+COM studios and prominent scholar in the field of Media Art & Design. He has ample experience with digital materiality and interaction design and has previously collaborated on various projects for museums and galleries.

16.	**Jane Alexander** 9/06/2022	Chief Digital Information Officer for the Cleveland Museum of Art, a tech pioneer in the American museum sector. Mrs. Alexander leads strategy, concept, design, and implementation of interactive experiences, having a holistic understanding of technology applications in the museum setting. In her current position, she has been engaged in various innovative projects targeted at improving the experience of the museum visitors.
17.	**Abner Preis** 14/06/2022	Content creator in XR with previous experience working with museums and large exhibitions on VR/AR projects. Founder of Abner Preis Studios, an experiential art studio based in Amsterdam, focused on storytelling and new media. Mr. Preis's ample experience in the field of XR accounts for his insightful understanding of how to develop impactful storytelling using technology.
18.	**Licia Calvi** 14/06/2022	Senior lecturer and researcher at the Breda University of Applied Sciences at the Academy for Hospitality and Facility. Her research focus is on museum experience design and the use of digital storytelling for cultural heritage, including the study of the impact of immersive technologies. Her research experience is highly valuable for exploring the intertwinings between forms of technological innovation and visitor experience.
19.	**Gianfranco Quaranta** 18/06/2022	Senior Project Manager highly experienced in AR exhibitions, a case in point being "Archeologia Invisible" for the Egyptian Museum in Turin. Mr. Quaranta's past collaborations offered him a deep-rooted understanding of how technology can enhance the visitor museum experience.

Appendix B- Interview Topic Guide

Strategic innovation	
Technological innovation	"What big developments have you seen in the past years regarding new forms of technology and how should innovation be understood in this new technological landscape?" "Which technologies do you find the most promising for innovating the museum experience and why is that?"
Strategic differentiation	"How can technological innovation be used as a strategic tool?"
Innovation processes	"From an operational point of view, what is needed in order to be able to deliver meaningful experience through technological innovation?" "How do you measure the acceptance rate and the intention to use before implementing technological innovation?"
Visitor engagement	
Storytelling	"What is the role of storytelling in the museum experience?" "How can museums narrate stories using XR technologies?"

Immersion	"How are museums using immersive technologies to provide meaningful experiences?"
Emotional engagement	"How should emotions be understood in the context of XR experiences?" "How can XR experiences trigger emotional responses?"
Cognitive engagement	"How can XR experiences stimulate knowledge transfer to the visitor?" "How can XR engage the visitor in learning experiences?"

Visitor participation	
Interactivity	"How do you understand interactivity in the museum context?" "How can XR bring new forms of interactions in the museum experience design?"
Game design	"How can games be used in XR experiences in the museum context?"
Personalization	"What would personalization entail for the museum experience that integrates XR technologies?"

Social interaction	"What role does the social dimension play in XR museum experiences?"

Experience co-creation	
Pre-visit phase	"How can museums create the experience together with visitors before the visit?"
On-site phase	"How can museums create the experience together with visitors during the visit?"
Post-visit phase	"How can museums create the experience together with visitors after the visit?"

REFERENCES