

Handbook of Research on Museum Management in the Digital Era

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Chapter 5

Making Smarter Museums Through New Technologies

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ABSTRACT

Smart technologies have a significant potential to impact people's behaviours thanks to their ability to increase access to different resources and the ability to influence technology-based encounters. The objective of this chapter is to deepen the theme of smart technologies in the museum environment, to describe the elements and the main dimensions capable of impacting both visitors' perception and overall experience. The authors analyze the use of smart technologies to 1) increase people's knowledge and skills in providing intelligent service in cultural heritage and 2) promote the involvement of visitors and improve their experience. Findings show that visitors increasingly lose the role of passive users to play an active role in the co-production of museum experiences. Smart museums lead to cognitive and engaging learning, touching, feeling, and experiencing different emotions, encouraging a return to the museum, inviting to learn, and shaping one's personal experience.

Smart technologies have a significant potential to impact people's behaviors thanks to their ability to increase access to different resources (Kaartemo and Helkkula, 2018) and the ability to influence technology-based encounters (Mele and Russo Spena, 2019). With the use of smart technologies, people are able to use and/or deliver a smart service based on their interaction with digital tools that perform, in an automatic and/or semi-automatic manner, tasks and objectives that traditionally required human intelligence (Huang and Rust, 2021). Nowadays, advancements in technologies have profoundly changed the formats and characteristics of many sectors, including the cultural one, with reference to museums. Accordingly, a new concept of the museum is emerging. The concept of a "smart museum" is associated with a clash of different cultures and the promotion of new ideas and projects, as well as

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innovative artistic solutions, aesthetics, feelings, and experience. More precisely, a smart museum is a specific application of building intelligence in the field of culture and expo; it is more scientific, more standard, and more specific, and the goal is clearer (Wang, 2021).

Consistent with these premises, there is a need to investigate how the smart technologies' development impacts the museum experience. Therefore, this chapter aims to deepen the theme of smart technologies in the museum environment, to describe the elements and the main dimensions capable of impacting both visitors' perception and their overall experience. This chapter is characterized by two sections. The first one regards a theoretical study on the theme of intelligent technologies or "smart technologies", highlighting how the introduction of digitization processes has changed the museums' formats and characteristics. The second section analyses the application of intelligent technologies in smart museums looking at national and international best practices. The authors analyze the use of smart technologies to a) increase people's knowledge and skills in providing intelligent service in cultural heritage, b) promote the involvement of visitors and improve their experience. Technology-mediated cultural services complement day-to-day operations but do not eliminate the need for traditional face-to-face interactions. The findings show that visitors increasingly lose the role of passive users to play an active role in the co-production of museum experiences. Specifically, smart museums lead to cognitive and engaging learning, touching, feeling, and experiencing different emotions, encouraging a return to the museum, inviting to learn, and shaping one's personal experience. In this information exchange, both visitors' knowledge and experiences come into play, laying the cultural foundations on which the visitor museum experience is built. The presented case studies show that a smart museum makes its cultural heritage knowledge usable and creatable by both classes of users: museum visitors and museum professionals. This chapter contributes to the current academic debate on defining museums as a smart environment where visitors can acquire cultural heritage content by interacting with the surrounding environment and the smart objects included in it.

INTRODUCTION

Smart technologies have a significant potential to impact people's behaviors thanks to their ability to increase access to different resources (Kaarremo and Helkkula, 2018) and the ability to influence technology-based encounters (Mele and Russo Spena, 2019). With the use of smart technologies, people are able to use and/or deliver a smart service based on their interaction with digital tools that perform, in an automatic and/or semi-automatic manner, tasks and objectives that traditionally required human intelligence (Huang and Rust, 2020).

A smart service encounter occurs when a user takes part in the service co-creation process by leveraging a wide range of cognitive and digital tools (Larivière et al., 2017). Ostrom et al. (2019) shed light on four key advantages people can count on when using technology-based AI-powered services: 1) greater personalization leading to richer and more satisfying experiences; 2) improved decisive skills; 3) greater convenience and savings of time; 4) responsible behavior of people.

Therefore, thanks to smart technologies, a new service supply is being tested.

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The concept of smart technologies still has ambiguous definitions (Neuhofer et al., 2015). Most studies are based on computational components that provide cognition as a service (involving three L: language, learning, and levels) and enhance human skills (Spohrer & Banavar, 2015).

The effective application of computational technology requires the conception of modeling, design, and evaluation of common human-machine cognitive systems (Hollnagel and Woods, 1983). Furthermore, cognitive technologies offer promising ways for people to innovate (Demirkan et al., 2015; Ng & Wakenshaw, 2017), thanks to their ability to use knowledge databases. In this perspective, smart technologies allow wider applications for increased human-machine interactions (Huang and Rust, 2018; Wirtz et al., 2018) not only by transforming data into usable intelligence but also by incorporating digitally enhanced systems into human lives. (Demirkan et al., 2015). They play an important role in influencing visitor behavior and, at the same time (Samara et al., 2020).

As smart technologies are used to integrate and augment human capabilities (and not to replace them), they can enable emerging resource integration processes (Russo Spena and Mele, 2019). In other words, smart technologies:

- 1) expand the resources' accessibility to help people make better decisions based on huge real-time data and multiple interactive responses;
- 2) extend all actors' involvement;
- 3) allow users to make lasting changes;
- 4) increase people's actions;
- 5) help actors to continuously monitor, update and refine their decisions.

In today's society, the development of Internet technology has had a profound impact on all aspects of social life (Wang, 2021). Particularly, technological advancements have had several important positive outcomes in the cultural heritage context. The emergence of the Internet of Things (IoT) has further expanded the Internet, which can communicate and exchange information between any objects. Therefore, it has undergone technological changes in many industries, and the application of related technologies in traditional industries has been expanded. In this direction, museums are becoming smarter and smarter in many activities. The Internet of Things (IoT) and smart technologies support the creation of smart museums based on digital infrastructure and information systems that have been deployed in modern museums. The development of complex interactions between interdependent actors, supported by smart technologies, allows tourists to obtain more detailed information on elements of interest and improves their experience from an emotional point of view.

To deepen the theme of smart technologies in the museum environment, to describe the elements and the main dimensions capable of impacting both visitors' perception and overall experience, this chapter consists of two main sections. Specifically, the first one includes a theoretical study on the theme of smart technologies of the main features and factors of impacts. In particular, the study highlights how the introduction of digitization processes has changed the vision of cultural heritage; the second section analyses the application of smart technologies in smart museums looking at national and international best practices, highlighting their characteristics, strengths, and weaknesses.

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THEORETICAL BACKGROUND: SMART TECHNOLOGIES AND THEIR APPLICATION IN CULTURAL HERITAGE

The recent technological advancements offer new opportunities for visitor attractions such as museums to provide a unique visitor experience. Museums communicate with the public in the way of the smart museum and contribute to human culture (Bae et al., 2013).

The advancements in technologies have contributed to modifying the characteristics of many sectors, including the cultural one. Accordingly, the benefits linked to technological development can appear at multiple levels even in cultural organizations, such as museums. The introduction of smart technologies is fundamentally changing the practices of non-profit organizations such as museums, which are seeking to explore the potential provided by digital technology, to enhance social value for their audiences and promote cross-cultural understanding, whereby some of them have successfully achieved new ways of interacting and sharing information (Rivero Moreno, 2018; Stromberg, 2013; Wang, 2014). For instance, virtual exhibitions curated by museums influence the audiences' aesthetic experience and their intention to visit the gallery physically while targeting segments of the public that are interested in new types of interaction (Carrozzino & Bergamasco, 2010; Lee & Jung, 2019). When museums attempt to balance social and commercial missions, the implementation of new digital technologies can be the turning point, as it has the potential to increase customer value and create new values (Oze et al., 2022). Specifically, customer values enhance organizational performance by appealing to customers to either pay a higher price for an offering or make recurring and more frequent purchases (Alshawaaf & Lee, 2020). The second dimension is the new value creation achieved by making a new offering that provides new value for customers, allowing more convenient delivery of the offering that entices them to purchase (Amit & Zott, 2001). The success of new value creation relies partly on its adoption by customers and the subsequent effect on the organization (Abdelkafi et al., 2013).

In this light, the introduction of new technologies has made it possible to create new cultural products that on one hand preserve over time their intrinsic value as cultural resources and on the other hand allow multiple forms of the cultural offer *tout court*. It is possible to identify three different ways through which the new technologies can create new opportunities for the cultural organizations (see fig. 1):

- the reproduction of the cultural service
- the improvement of an already existing cultural service
- the design and planning of a new cultural service

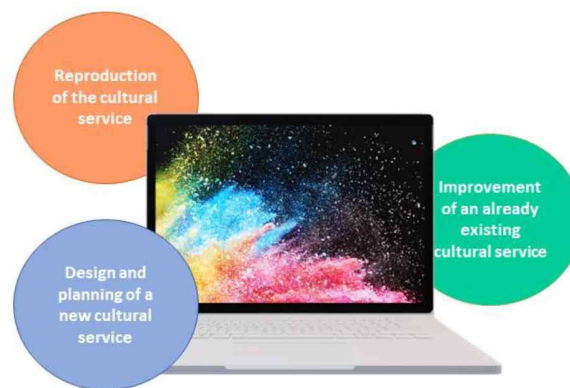
In the first case, the technology is used to codify a cultural service to allow its use in another space and/or at another time. The second point refers to specific technologies used to overlap some limitations a cultural service can possess. At least, the third point regards the situations where there is the highest integration between the technologic resource and the cultural one. More precisely, it contemplates technological innovations useful for creating new services that were previously not feasible. An example of this is the development of new ways of visiting the archaeological areas linked to the use of three-dimensional (3D) graphics.

In this light, an important concept to take into consideration is related to the Internet of Things (IoT) paradigm. It supports the transition from a closed world, in which an object is characterized by a descriptor, to an open world, in which that object interacts with the surrounding environment because it has become "smart". Specifically, thanks to recent advances in miniaturization and lower cost of RFID,

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Bluetooth, sensor networks, NFC, wireless communications, technologies, and applications, IoT is gradually acquiring a pivotal role in several research fields (Wang, 2021; Hamidi and Jahanshahifard, 2018). In the more recent years, cultural heritage has been revealed to be one of the most suitable domains in which such achievements can be exploited, since it characterizes a domain where many aspects have to be considered at the same time: logistics, economy, tourism, entertainment, etc. Different areas of interest of the cultural heritage can be conceived as environments where people are in contact with a reality of objects capable of arousing interest and excitement.

Figure 1. Implementation of technologies in cultural services



The new ICT technologies and services aim to facilitate the integration between the digital and real dimension in an environment, which has to become smart (Balakrishna, 2012). In a smart cultural space, technologies must be able to connect the physical world with the world of information to amplify the knowledge, but, also and above all the fruition, involving the visitors as active players, which offer the pleasure of perception and the charm of the discovery of new knowledge.

The cultural heritage is very much involved in digital transformations, increasingly qualifying them with expressions such as museum 4.0 or Smart Museum.

Smart museums are the environment where visitors can gain access to content in museums using smart devices and participate in museum activities anywhere (Bae et al., 2013). They are conceived as museums in which visitors can innovatively access content by resorting to simple technological solutions (for example, the QRCode, the two-dimensional barcode now widely used in various forms of communication) or more sophisticated: for example, through the use of beacons, small devices capable of communicating via Bluetooth thanks to the scanning of the work through the photographic sensor of the portable device that people are using at that moment.

In the context of the smart museum, the evolution of the latest technologies makes it possible to make each work (through sensors) able to identify the approach of a user and communicate this information to a centralized information system.

Thus, a museum populated by smart objects – the artworks, therefore, capable of acquiring information from the external context, identifying the approach of a visitor equipped with a mobile device

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- becomes itself “smart”, because it can decline its system of knowledge according to the “implicit” requests formulated by each visitor.

In addition to information technologies linked to the Internet infrastructure, a further technological change that has taken place in recent years is linked to the development of a new class of electronic devices that have changed how individuals interact with information: mobile devices (Solima, 2016).

In particular, mobile devices close the gap between online and offline and integrate online and offline spaces. Due to this integration, learning is possible anywhere and anytime. If smart learning is a form, which actively supports interaction between individual learning and a learner then the smart museum is a museum where the concept of smart learning is adjusted and indicates that the principle of integration can be explained as a special feature of the smart museum. The possibility of a smart museum and smart learning is based on the assumption that a considerable portion of the public uses smart devices.

Mobile devices are equipped with an advanced communication system that allows them to connect both to the web and other devices, via Wi-Fi or other data transmission technologies (Bluetooth, NFC, Wi-Fi Direct, etc.). In most cases they can function as GPS navigation systems, making it possible to know the exact position of the owner, as well as being equipped with one or more cameras with which to take photographs or shoot videos.

This type of device is divided into three categories, depending on the size of the screen or the way of use: smartphone, tablet, and wearable.

With specific reference to the wearable category, in the case of smartwatches, these devices can connect to one of the devices belonging to the network either independently or through a Bluetooth connection.

One of the main advantages derived from the use of mobile devices is the possibility of being continuously connected to the Internet (always-on) to have access to innovative services that take full advantage of its features.

An example of this possibility is the choice of the Museum Quarter in Vienna to define a hashtag to gather all photos visitors published on Instagram, thus greatly amplifying their digital contents, which include both institutional and user-created ones.

Correct use of mobile devices within the museums’ context can easily make them more accessible, as shown by the Metropolitan Museum of New York that after an initial trial period in which users were able to interact with the museum through a dedicated section of their website, has decided to develop an *ad hoc* App, the MetApp. This is not limited to providing information on the nature of the collection, but it is a real digital assistant in the use of the museum services, providing the visitor with suggestions on the artworks to see based on the contents already visited and those that the visitor has decided to save in a dedicated area of the app. In addition, the museum has designed the software to be compatible with the screen-readers necessary for visually impaired people to be able to enjoy the content. Another example is the Brooklyn Museum which has developed an app for museum visitors. Specifically, the app ASK Brooklyn Museum allows to reduce the negative impact of barriers related to cognitive accessibility because it allows visitors to get in touch with both a team of experts (the museum has set up a team composed of an archaeologist, an anthropologist, an art historian, and other training experts) and with other museum visitors, to obtain information on the artworks they are admiring informally.

A further example of the use of these devices to improve the use of cultural resources is linked to the use of QR codes. Their use is now very widespread in museums all over the world, as they can be created at no cost and then used to provide additional information to their primary services. For example, the Santa Cruz Museum of Art & History at the McPherson Center in California used QR codes in one of its handicrafts exhibits to combine multimedia content with the real exhibition.

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The possibility of being continuously connected to the web is only one of the innovation sources that links mobile devices to the cultural services, including those one offered by museums; these devices include several technical features that allow the creation of innovative services. An example is given by the Louvre app called “My visit to the Louvre”, which allows the user to use their device not only to obtain information on the various collection masterpieces; thanks to the use of Bluetooth beacons within the museum structure, the visitor can use the GPS position to define personalized routes that are displayed in a 3D map. Furthermore, the user can purchase, directly within the app, one or more 600 audio guides made available by the museum. Of course, this represents additional financial resources for the museum.

In general, digital technologies and, in particular, mobile devices are considered key elements to valorize the cultural heritage (Tallon, 2008).

Thanks to the implementation of technologies applied to the cultural context, the visitors’ experience change it is no longer passive, but becomes active, engaging, and interactive because it is based not only on the observation of the collection (on-site) but on a selection of contents visitors choose to use (Triunfio et al., 2021). Accordingly, they can have the opportunity to test their knowledge, have fun with games and quizzes and share their impressions on social networks.

Cultural heritage digitization and smart and open strategies have become crucial museum innovations (Pallud and Monod, 2010; Parry, 2005; Serravalle et al., 2019). Leveraging on digital and advanced technologies (Fenu and Pittarello, 2018; Schaper et al., 2018; Trunfio et al., 2020), museums are providing new ways of displaying artworks that capture visitors’ attention, enhance their experience, and improve scenography and exhibitions, making the museum more accessible to a wider audience (Camarero and Garrido, 2012). As technology may also create new forms of creative processing, in addition to shaping the processes more efficiently (Hunter and Fairchild, 2013), technology-driven creative processing may also generate new symbols, meaning or content, and new cultural products and services (Della Lucia & Trunfio, 2018).

As before-mentioned, the technologies introduced within the museums’ context are multiple and consist of apps for mobile devices, touch and multi-touch installations, based on the interaction with touch-sensitive surfaces, 3D animations, Augmented Reality applications (AR - Augmented Reality), and Virtual Reality (VR - Virtual Reality), etc.

More specifically, AR is a digital representation in which artificial/virtual sensory information is imposed on the normal reality perceived through our senses, such as texts, images, 2D/ 3D animations, audio and video elements (He et al., 2018; Ozer et al., 2022). Generally, a smartphone or tablet is then used, observing on the screen the additional information, which “increases” reality, placed on different levels (layers), which can be activated by the user (Tom Dieck et al., 2016; Sezgin and Karaman, 2022).

On the contrary, VR is a three-dimensional environment generated by a computer in which the subject or subjects interact with each other and with the environment as if they are really inside it; for this reason, it is an “immersive” technology as it can create a sense of sensorial “immersion” in the digital environment.

The goal of AR is, therefore, to give the feeling that virtual objects are present and integrated into the real world. VR, on the other hand, uses viewers, which prevents the vision of the surrounding reality, which is replaced by a digital version. Therefore, VR applications are decontextualized, being able to be used not only in any specific spaces made available by the cultural enterprise but also in other contexts.

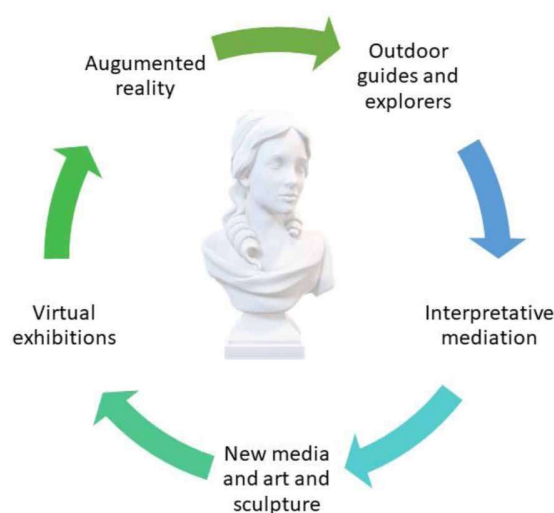
AR technology applied to cultural heritage and making specific reference to a museum allows the visitor to experience a unique and highly engaging experience.

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This technology had its first application in the museum field in 2001 with the Archaeological Virtual Dig, a multimedia excavation project carried out by the Seattle Art Museum. A few years later, in 2005, Doshisha University in Kyoto presented the time machine navigation system. The potential of AR technology for the enhancement of cultural heritage has also been understood in the European continent, prompting the European Union to finance a series of research.

As can be seen from Figure 2, the main applications of AR technology to cultural heritage can be classified into four types (Mannion, 2014).

Figure 2. AR and cultural heritage



The first category “outdoor guides and explorers” includes all the initiatives in which the AR is used outside the museum as in the case of the Streetmuseum of the London Museum, which uses the photographic heritage of the museum to create an app that, used in the city of London allows the user to see how some points of interest have changed over the years by exploiting the GPS signal of the mobile device to locate the user.

The second type related to “Interpretive mediation” refers to cases in which AR is used to provide additional information on artworks. An advanced example of this type of use of AR was that of the British Museum’s Mirror application in which, through a webcam, the users’ faces are recognized, and a unique mask is virtually drawn from the Baroque collection of the museum.

The third and fourth typologies, respectively “new media art and sculpture” and “virtual exhibition”, are linked to the possibility to use AR to create new art forms or, in the most complex cases, even new completely virtual exhibitions that merge with the real ones using a personal device as an observation window, as in the case of the Manifest.AR by Sander Veenhof. Manifest.AR is an international collective of artists working in the augmented reality domain. Installing their work virtually, at a distance, and without the need for them to be physically present anywhere, their artworks defy borders, physical boundaries, or any thinkable limitation of whatever kind. The MoMA Museum New York uninvitedly hosts a Manifest.AR exhibition, there are virtual objects inside the Oval Office and Pentagon. Manifest.

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AR is everywhere! In other words, thanks to AR, it is possible to create a virtual exhibition via a telephone app to be used at MoMA New York to view an alternative exhibition.

What has been described determines a series of benefits for the cultural organizations: firstly, it improves the visitor experience and the overall satisfaction of the user experience, secondly, it allows the data collection on visitor behavior; third, it determines a greater attraction of the cultural firms towards younger visitors and finally, it encourages the cultural organizations to activate collaborative relationships with private firms.

Visitors will also be able to count on several advantages deriving from the use of these technologies: first of all, they will be able to access additional information supports automatically, even though their mobile device (Bring your device); secondly, it will benefit from new learning contexts (real/digital world), which go beyond the traditional visit model (passive use) and increase its level of interaction; third, it will be able to determine easily and with greater autonomy how to use the time available within the cultural institution.

Methodology: the Case Study Approach

To exploration to the theme of smart technologies in the museum environment and to describe the elements and the main dimensions capable of impacting both visitors' perception and their overall experience, we adopt a phenomenological research methodology (Bogdan and Taylor, 1975) and employ an interviewing method of data collection and analysis (Smith et al. 2009).

We chose a phenomenological approach because it provided us the opportunity to gain knowledge of visitors' everyday experiences (Merleau-Ponty, 1962). Specifically, it allows us to understand how visitors interact with the world they live in (Lanigan, 1979) and investigate their experience (Gill, 2015). According to the phenomenological approach, the researcher places his/her interpretations aside and presents the raw descriptions provided by the subjects (Sanders, 1982). To collect a diverse range of experiences with smart technologies in the museum context we decided to investigate and interview smart technologies users. The methodology chosen is an investigation through multiple case studies that offer a wide opportunity to observe and investigate the phenomenon in company realities (Yin, 2009). We choose it because it is useful for inductively developing a theory through the description and analysis of new phenomena (Baker and Foy, 2003). Collecting empirical material from multiple sources allowed us to perform a triangulation of data (Yin, 2009; Piekkari, and Welch, 2018). Data triangulation was also employed using tools such as documentary analysis, direct observation, and informal conversations. The use of triangulation in qualitative research helped evaluate a phenomenon through multiple perspectives and sources, thus ensuring higher confidence in grasping meanings from real contexts.

In particular, to carry out the data collection, we elaborated and followed the case study protocol as suggested by Yin (2009). This process included several steps as follows: (i) research questions, (ii) research method, (iii) permission seeking, (iv) ethical considerations, (v) interpretation process, and (vi) criteria for assessment. This choice is justified as the multiple sources combination of empirical material in a case study method is often identified as the best strategy for adding rigor, breadth, complexity, richness, and depth to a study (Flick et al., 2004).

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Case Studies: Smart Practices in Innovative Museums

National Archeological Museum of Naples (MANN) Digital Strategy: A Smart Interaction Practice

The lockdown experience related to the Covid-19 pandemic has produced very different impacts on people who have experienced it. In general terms, it seems that a common denominator is constituted by a different and wider predisposition to the use of digital platforms, both for the creation and/or maintenance of personal relationships, both for access and exchange of knowledge and information.

This finding reinforces the idea for Italian museums and foreigners, of the general lack of a digital strategy that can systematize the contents already available and those to be created, maximizing the effectiveness of the overall use of these resources. For this reason, it was intended to attribute a specific value to the development of the National Archaeological Museum of Naples (MANN) Digital Strategy, which is not only consistent with the strategic objectives, but it is also able to support the entire path strategy of the museum, feeding in various ways the different activities that it proposes to carry out, to achieve the objectives it has set itself.

MANN is one of the oldest and most important cultural institutions in the world for the richness and uniqueness of its heritage and its contribution to the European cultural scene. Impressive in its architecture and collections, and a key player in cultural life in the city, the museum is an essential stop on an initiatory journey into the world of antiquity.

The origin of its collections is linked to the figure of Charles III of Bourbon who, having ascended the throne of the Kingdom of Naples in 1734, promoted the exploration of the Vesuvian cities buried by the volcano's eruption in 79 AD and the project of a Farnese Museum, with the transfer to the city of part of the rich collection inherited from his mother Elizabeth.

His son Ferdinand IV decided to bring together in the actual palace both the Farnese collection and the Vesuvian one, which constitute the two main areas of the Museum.

The palace, built at the end of the 16th century as a knighthood and, since 1616, as the seat of the University, was involved in a long phase of renovation and enlargement works starting from 1777, entrusted to the architects Fuga and Schiantarelli. Conceived as an encyclopedic institution, the building was home to various institutes and laboratories (the Royal Library, the Academy of Drawing, the Papyrus Workshop, and an astronomical observatory never completed), later transferred to other locations. With the unification of Italy, the Museum became National. Its collections were progressively enriched through the finds from excavations conducted in Southern Italy, as well as from private collections.

Among the digital tools used, it is possible to mention video stories, 3d glasses, interactive and virtual applications, and smart guides.

The digital resources of the MANN consist, in the first instance of texts, drawings, images, and digital reconstructions of artworks and contexts related to the museum, its permanent collections as well as the objects and artworks preserved in its deposits. These resources constitute an increasingly important component of the relationship between the museum and visitor/user and increasingly contribute to redefining the experience of use and the relationship - even at a distance - with the museum. Digital resources can be conveyed through different channels, both within the museum, between one functional area and another, and towards the outside, to the extent that they are made available to other museums and cultural institutions, to the community, science and museum visitors/users. Systematic and efficient use of the

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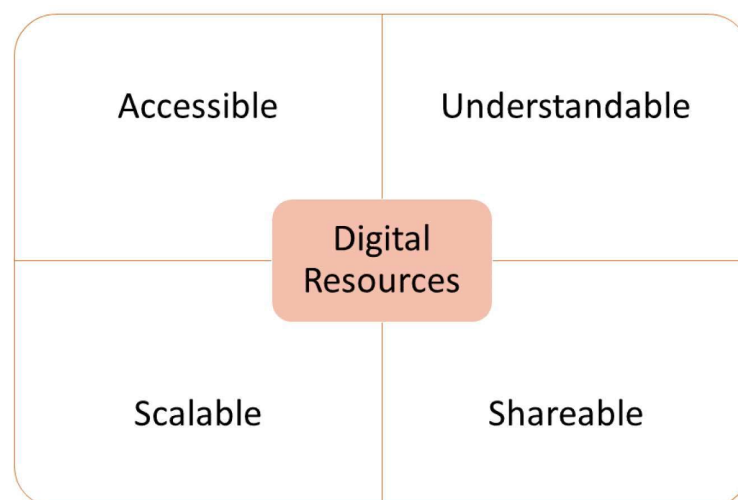
digital resources of the MANN presupposes the existence of a high level of internal coordination among the various employees who produce and use the digital resources of the museum in various capacities.

In general terms, the MANN has equipped itself to increase progressively its offer of digital information resources, creating increasingly rich and varied materials, in content and formats, to maximize their value in use as well as the involvement of the various recipients, also to strengthen the existing link with the museum. The digital assets produced by the MANN are therefore easily accessible and understandable; the textual ones are therefore be written in the simple (non-specialist) language, are structured with progressive levels of detail, and are easily identifiable (Fig. 3).

MANN, therefore, set itself the goal of enhancing its collections by stimulating interest and curiosity around the artworks that compose them, favoring a progressive and gradual process of deepening and learning, guiding the transition from a simpler first level of information to a more precise and articulated one. The museum is extending the level of involvement of its audiences, both in a cognitive and temporal sense, also by promoting opportunities for interaction and socializing.

The digital resources of the MANN are easily shareable and sociable, both inwards and outwards, through any platform that is compatible with their specificities. In other words, putting digital content online - for example, through a post on a social network - isn't so much and not only constitute the outcome of a museum's communication activity but rather represent the triggering moment of a viral process of dissemination and creation of further digital content, through the active participation of users. Finally, digital resources are able to be used with different devices, fixed (PC, TV, console, etc.) and mobile (smartphone, tablet, and wearable), independently from the platform that conveys them (social, site, app), and are therefore able to transit freely from one platform to another, respecting the relative characteristics. Concerning communication via social media, for example, it is possible to identify, for each digital resource available, which is the transmission channel to the outside that is most suitable at that moment: a video can be conveyed through Facebook or YouTube or Instagram or TikTok; the choice is made consciously and coherently, that is, according to the nature of the contents and the segment of demand to be reached.

Figure 3. The digital Resources of Mann



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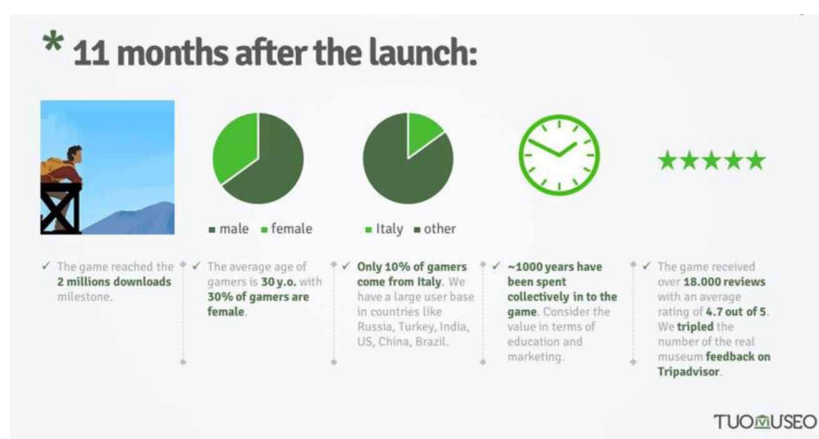
In this perspective, the system is implemented to collect data relating to the use of the museum's digital resources, to monitor the performance achieved as well as to assess the online reputation of the museum (for example, through the cd. Sentiment Analysis), also to optimize the possible use of digital advertising campaigns, to be carried out on the occasion of large exhibitions or events of particular importance. In the production and dissemination of digital content, it, therefore, has in mind the characteristics and expectations of the different types of digital users, to which the museum intends to turn. As in the case of visitors, not it is possible (more) to consider the museum public as an indistinct audience towards which an undifferentiated message can be conveyed, but it is analyzed and distinguish the different categories of users to whom the museum decides to address, declining its communication and the tools used precisely because of their respective wishes (and thus developing a personalized smart interaction)

"I visited the Mann both through digital resources and in person, it was a unique experience for me, for two reasons: the first reason is that I felt understood as if the services had been provided specifically for me ... as if knew my rights and my needs, this allowed me to interact more quickly with the staff of the museum; the second reason is that I felt part of a community I met people with my same cultural needs we interacted and socialized among us ... and we still continue to do so because we share the same passions ... I continue to digitally view the Mann almost every month to be informed about the news" (source: Visitor, Mann)

To understand in a transversal manner and operational terms the methods of applying smart technologies in museums, a smart interaction practice is represented by the case of *"Father And Son"* (Fig.4 and 5).

It is one of the gamified projects that work on the wave of gaming tourism. This is a new form of tourism, virtual and real while pushing players from all over the world to interact smartly and to travel to the places where their favourite games have been set. The basic concept is like film tourism and its diffusion, above all thanks to the characteristics of our country, is very wide. The video game used by MANN has been made available for free on the Apple and Google stores since April 18, 2017. In less than a year, the game was downloaded about 2 million times by an international audience. Only 10% of the total players are Italian, while the majority come from India and China. The average player of Father and Son is 30 years old, while 1000 are the years of life spent overall by the total number of players, 70% men.

Figure 4. "video game used by MANN"



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The winning idea of the game is not only to rely on the popularity of the areas shown or the museum but to be fully connected to them through a check-in system. A novelty for an app of this type and which allows players to obtain in- additional games, such as extra areas, customization options for their character, or the same original soundtrack if they physically go to the Museum. This is done by recognizing the player's GPS position. Privileges of this type, therefore, require the physical presence of the player in Naples, more precisely inside the museum, with the need to pay the entrance ticket. The latest data shows that this content has been unlocked by 18450 people, certifying a direct impact between video games and real visits. In 2017, the MANN recorded record entries, exceeding the historic milestone of 500,000 visits in a year, these occurred in April and May, immediately after the launch of the app.

In general, the perception of Naples and the Museum has also increased thanks to the game: Google data underline that in 2017 this is the most searched Italian city online, with an increase of 25% compared to the previous year.

A sequel to the video game is also being studied, with a release scheduled for spring 2018 and a theatrical transposition of the story, with a performance that will be presented to the public by the summer of 2018.

Figure 5. "Father and Son"



In conclusion, it can be said that the MANN obtained from the app:

- a strengthening of its image to the public, having been associated with a successful game and showing itself to be dynamic and capable of innovating and differentiating itself, experimenting with new ways and technological solutions;
- greater visibility, having produced a game of a high quantitative level, with an average of 4.5 out of 5 reviews which were also recognized by Apple, which has chosen to place
- an increase in its usability, having created a product that can - by its nature - also be enjoyed regardless of the physical presence of the visitor; a museum, therefore, that transcends its physical boundaries to get closer, with new and different forms, to its audiences, especially those who, due to their geographical distance, may never visit it;

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- the creation of an emotional bond with the player, through the engaging and touching plot of the game the player can increase the level of sentiment towards the museum and create a relationship of loyalty; Father and Son on all world stores as a showcase product;
- an increase in attractiveness towards new audiences, the presence of a mechanism for unlocking additional video game contents, linked to the physical presence of the visitor at the Mann headquarters, can represent a further stimulus to go to the museum, compared to that generally connected to the aforementioned videogame tourism.

Virtual Tour of the “Capitoline Museums”: A Smart Knowing Practice

The Capitoline Museums are the main civic museum of Rome. The historical site was established in the Palazzo dei Conservatori and the Palazzo Nuovo. The two buildings are in Piazza del Campidoglio renovated following the design of Michelangelo and are joined by the Lapidary Gallery, an underpass that crosses Piazza del Campidoglio without leaving the museums.

Today, to offer a journey to discover the beauty of heritage, a virtual tour of the Capitoline Museums has been developed, accessible from all devices, providing a digital experience that goes beyond spatial limits in almost all of the museum space. Thanks to the special controls, tourists can virtually move around the museum, read the explanatory panels of the rooms and artworks, zoom in and rotate the images 360 °, scroll through photo and video galleries and enjoy other contextual content. The application of smart technologies for tourism purposes is part of new development to explore knowledge in such a way that new forms of knowledge can emerge. With the virtual tour, the tourist has a knowledge interaction with human actors, non-human actors, or a mix of both, living a phygital experience

The virtual tours of the civic museums, for example, offer a full-screen visit of the rooms and allow a virtual experience for all that goes beyond the limits of space. Using the mouse and keyboard, clicking on the hotspots inserted in the rooms, and browsing the interactive maps, the visit is deepened with context elements: photos, videos, texts, and the path is freely chosen by the visitor.

“It is my third virtual tour of civic museums, every time I connect, I know something new. I immerse myself in the visit and through virtual reality and I manage to satisfy all my cognitive needs by moving from one area to another ... I think that next week I will do another tour because in each tour I know something new that I like to learn more about ” (source: User, The Capitoline Museums)

Available in both Italian and English with over 300 rooms and thousands of artworks, the 8 civic museums offer a free virtual tour enriched by images, videos, audio and informative texts.

The visit can be used on any type of device, even from mobile devices such as smartphones and tablets, with additional support such as the special cardboard or VR viewers.

The virtual tours cover almost the entire museum space with multimedia content, 360 ° photographs that can be navigated through a special control panel to move virtually inside the rooms, explanatory panels of the rooms and artworks, commands to zoom and rotate 360 ° the image, route map, photo galleries, videos, and other contextual content.

The “not to be missed” section, containing a practical visual list of selected artworks or rooms, is a useful tool for those who are unfamiliar with the museum and are visiting it for the first time.

Finally, in the Virtual Tours of the Centrale Montemartini, the Museum of Rome, and the Museum of the Walls, thanks to the latest generation drones, the visitor can see rooms and works from above, enjoying a further and unprecedented perspective of visiting the museum and of the city (Fig 6).

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Figure 6. “the Virtual Tours of the Centrale Montemartini”



MUVI Project: A Smart Learning Practice

The MUVI project - Virtual Museum of Daily Life - was born in 1999 from a reflection by Donatella Vasetti and Maria Chiara Liguori on Anglo-Saxon museums dedicated to everyday life. This type of museum, through the reconstruction of domestic interiors relating to various historical periods and different social classes, displays objects and historical sources that can be connected to everyday life. Food, family gathering, everyday objects tell stories and experiences. The spaces and their use tell of the historical climate, the links with the surrounding environment, the relationships between the sexes and the generations. The objects, both artisanal and industrial, make changes, stays, and social, cultural, and economic returns perceptible even to non-professionals.

These are significant achievements from a cultural and didactic point of view, very useful for bringing the general public closer to history. The comparison with the everyday life of the past attracts and intrigues people of all ages and can represent a valid stimulus to re-establish a communicative flow between generations. However, the creation of permanent installations is very demanding, both from an economic and practical point of view.

Information technologies were therefore identified as a possible and valid alternative and a small grant, obtained in the context of “Bologna 2000 - European city of culture”, allowed the project to be launched in collaboration with the CINECA VisIT Lab. In 2001, the first phase was completed, including the reconstruction in Virtual Reality of a domestic interior from the 1950s, historically supported by sources and in-depth datasheets, and a hypertextual and multimedia website dedicated to the history of Bologna from the end of the 19th century. to date. But the reconstruction of the 1950s house did not complete the initial idea.

In 2008, thanks to a grant from the Carisbo Foundation, it was possible to broaden the research chronologically through the project: “Living the newspaper”, created by Maria Chiara Liguori and Elena Musiani with the coordination for the historical part of the Bologna Committee of the Institute for the history of the Italian Risorgimento and the IT history by Antonella Guidazzoli of CINECA. The project allowed the reconstruction of domestic interiors for the 1930s and 1980s.

As for the reconstruction dedicated to the 1950s, the two new domestic interiors also started with buildings that exist in Bologna.

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For the 1930s, in a perspective between rationalism and domestic engineering, one of the villas in the “Village of the Fascist Revolution” by the Bolognese architect Francesco Santini was chosen. The intended use of the villas for families of Fascist mentors made us imagine that the one we reproduced could have hosted a PNF official who distinguished himself in the colonial wars in East Africa. Some elements arranged in the hypothetical study of this man, such as the Abyssinian trophies, reproduced from objects in the Museum of the Risorgimento, indirectly tell the story.

The house from the 1980s, less dramatized, is instead set in “Le Torri”, the residential complex built between 1977 and 1980 via Zago, in the exhibition center, by the Bolognese architect Enzo Zacchioli. It “hosts” a family projected towards technologies which, in that decade, had begun to assert themselves with arrogance and which, nowadays, dominate our lives unchallenged. To better measure the time, we decided to reconstruct the room of a hypothetical teenager, whose things, such as discs, CDs, and computers, also occupy other rooms in the house.

“Thanks to digital tools we have been learning the features of objects useful for furnishing virtual homes in a functional way to narration, the smart learning has given rise to valuable contacts with numerous private individuals, public and corporate archives, libraries, and foundations” (source: participant to the Muvi project).

The search for objects used to furnish virtual homes in a functional way to narration has given rise to valuable contacts with numerous private individuals, public and corporate archives, libraries, and foundations. Think, for example, of the collaboration offered by Villa Necchi Campiglio in Milan, owned by the FAI, which allowed us to reproduce various furnishings for the home of the 1930s. Naturally, they were chosen among the pieces used in the kitchens, in the office, or in other service environments, which could better adapt to a middle-class context, albeit crossed by the thrills of the international style, such as the one they propose.

The modeling and realistic rendering of objects and materials has often represented a challenge for Francesca Delli Ponti, but the passion for the realization has allowed her to progressively overcome the technical and organizational difficulties encountered, and now, all the people who worked on these new tranches of the MUVI project hope to be able to continue with the story of other historical periods (Fig. 7).

Google Arts & Culture: A Smart Sharing Practice

The Google Arts & Culture (formerly Google Art Project) is an online collection of high-resolution images of artworks exhibited in various museums all over the world, as well as one virtual visit of the galleries in which they are exhibited. The virtual tour allows tourists to see the artworks in high-definition sharing images and cultural information.

The project was launched on February 1st, 2011 from Google and includes artworks present at the Tate Gallery of London, the Metropolitan Museum of Art of New York, the Uffizi of Florence, and Capitoline Museums of Rome.

The museum exploration feature uses the same technology used by the project Street View, always of Google. Starting from 2016, a special robotic camera, called Art Camera, was designed for the digitization of images, which allows people to take photographs with a resolution of 7 gigapixels (7 billion pixels) and share them. Figure 8 shows the main museums present in this initiative of sharing.

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Thanks to Google Arts & Culture I was able to share with everyone my greatest passion, the passion for culture. I love to view and analyze images of works of art. Google Arts & Culture allows me to do this because it enables the sharing of high-resolution photos ... I can say that google gives a smart sharing of culture (source: User, T Google Arts & Culture)

Figure 7. The MUVI project

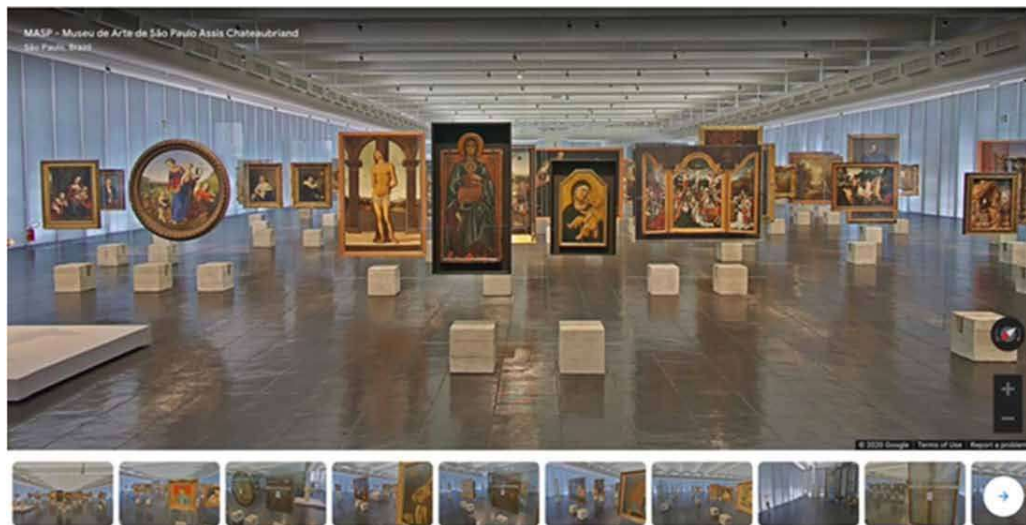
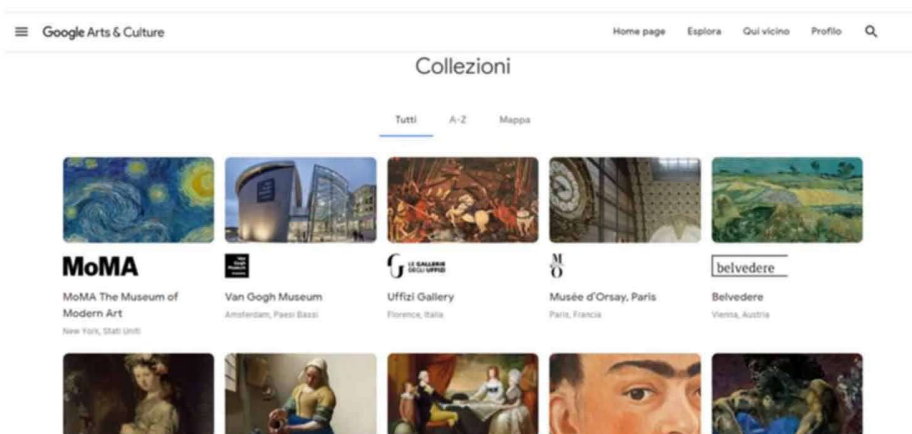


Figure 8. Google Arts & Culture Museums



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EMMA - Electronic Museum Management & Analytics: A Smart Integrating Practice

Emma - Electronic Museum Management & Analytics is a 360 ° museum management system. The modularity and scalability of the platform offer a customizable and adaptable service, with rationalized costs, better management of exhibits, bookshops, and integrated ticketing services accessible from desktop or mobile. The analytics system makes it possible to analyze visitor data anonymously and in aggregate, identifying the various segments of the museum's public in full compliance with the privacy protection criteria. Emma's main purpose is to optimize the experience of managing museum activities using a single flexible and modular system. The platform offers a series of web-based services, accessible from the desktop, and is integrated with a mobile app which, using the scanning and recognition of barcodes, makes the sales and cataloging processes simpler and faster, as well as allowing a parallel and displaced use of services.

The modularity and scalability of the software make it possible to offer a customizable and adaptable service to cultural realities of all sizes and degrees, supporting them in the process of automating, simplifying, and optimizing processes. Among the features of Emma, each of which can be individually added or removed according to the needs of the museum at each reactivation of the purchased plan, there are: the physical ticketing service, usable both via web interface and mobile app, designed to facilitate the sale of tickets and items on site by museum operators; the module dedicated to the management of the cataloging of items on sale at the bookshop, also usable both from the web and from mobile and conceived as a tool for registering orders and purchases made by the museum towards suppliers and consulting the inventory, with updates in real time; the event creation and administration service, which can be integrated with the museum's Facebook page; the booking service, with a control panel dedicated to operators; the online booking service, with visitor interface; the module for the management of shifts and personnel; the online ticket office administration section which, combined with the interface dedicated to visitors and customers, allows the museum to sell tickets and items via the web the data analysis & visualization service, which can be integrated and expanded with an innovative visitor tracking system within the museum; the "museum network" module, which allows the shared management of sales and admissions by several museums belonging to the same network, providing all of them with constantly updated reports and stocks.

The innovative aspects of the Emma project differ in terms of genre and relevance. Designed to make technological innovation within the reach of museums of any size and order of turnover, the first innovative element compared to existing systems lies in the accessibility of the cost of the package of services that can be purchased, which can be assembled according to the specific needs of the museum and can be customized in the time. The sales format is that of subscription services, and the composition and subscription to the service package is renewable quarterly.

"Emma allows you to interactively integrate various services, data and information. Smart integration enables the erection of ad hoc services, to meet the needs of museums and compliance with current regulations, such as those derived from the Covid-19 pandemic. The smart integration allows you to insert multiple services on a single platform, significantly reducing costs (source: developer, Emma platform)"

As the only platform is able to offer multiple integrated services, Emma will relieve museums from managing relationships with various suppliers and will release them from the imposition of adoption

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of selected hardware, allowing the use of its services through any desktop computer and mobile device, already in their possession. In addition to the functions strictly related to management, Emma provides for the integration of an innovative visitor tracking system within the museum itinerary, using tags which, communicating via UWB technology with anchors arranged inside the museum, allow the continuous localization of the visitor and the consequent collection of data relating to the visitor experience, as well as the reporting of non-compliance with the distancing if required by current regulations.

Finally, the flexibility of the system will allow developers to expand and continuously improve Emma's offer over time with new modules, in response to new problems and requirements collected by users.

DISCUSSION

This chapter contributes to the current academic debate on defining museums as a smart environment where visitors can acquire cultural heritage content by interacting with the surrounding environment and the smart objects included in it. It concerns the investigation of smart technologies in the cultural heritage. The main contribution lies in addressing how human actors interact, learn, know, and share new ways of information and experiences in the museum environment.

The findings show that visitors increasingly lose the role of passive users to play an active role in the co-production of museum experiences. Specifically, smart museums lead to cognitive and engaging learning, touching, feeling, and experiencing different emotions, encouraging a return to the museum, inviting to learn, and shaping one's personal experience. In this information exchange, both visitors' knowledge and experiences come into play, laying the cultural foundations on which the visitor museum experience is built. The presented case studies show that a smart museum makes its cultural heritage knowledge usable and creatable by both classes of users: museum visitors and museum professionals.

THEORETICAL AND PRACTICAL IMPLICATIONS

Exploring the smartness of the museum can inspire the research of relevant smart museum activities and help to establish a visiting area of smart museums with extensive scientific experience.

The theoretical contribution of the present chapter lies in understanding the role that innovation can play in defining a museum as smart.

Utilizing digital and smart technologies often leads to organizational innovation with positive implications that may include improving capabilities and competitive advantages. In particular, the introduction of smart technologies impacts the museums' business models, by innovating services that interact with customers to build relationships, create new experiences and engage more closely with audiences.

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As also above-mentioned, visitors will also be able to count on different advantages deriving from the use of smart technologies: first of all, they will be able to automatically access to additional information supports even through their mobile device; secondly, visitors will benefit from new learning contexts (real / digital world), which go beyond the traditional visit model (passive use) and increase their level

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of interaction; third, it will be possible to determine easily and with greater autonomy how to use the time available within the cultural organisation.

From a managerial perspective, this chapter provides useful insights for site managers and destination marketers attempting to increase the effectiveness of their heritage marketing and promotion operations with advanced technology. The introduction of technological tools stimulates future cultural tourist flows in creative ways, especially for eliciting the intention to visit a museum.

CONCLUSION

This chapter contributes to the current academic debate on defining museums as a smart environment where visitors can acquire cultural heritage content by interacting with the surrounding environment and the smart objects included in it.

It analyzes the use of smart technologies to:

1. increase people's knowledge and skills in providing smart services in cultural heritage,
2. promote the involvement of tourists and improve their experience.

Technology-mediated cultural services complement day-to-day operations but do not eliminate the need for traditional face-to-face interactions.

The forms of innovation introduced by museums by leveraging smart technologies and cultural heritage digitization enhance the value proposition and then, visitors' experience and satisfaction, also rendering the museum's cultural offering more accessible to a wider audience.

In this light, it is important to highlight some applications of smart technologies in museums, such as national and international best practices, and identify the importance of active participation for visitors to positively impact their experience also from an emotional point of view.

To sum up, what emerges from the case study analysis is that the visitor increasingly loses the role of the passive user to play an active role in the co-production of results. In this information exchange, the visitor's knowledge and experiences come into play, laying the cultural foundations on which the visitor museum experience is built.

REFERENCES

- Abdelkafi, N., Makhotin, S., & Posselt, T. (2013). Business model innovations for electric mobility—What can be learned from existing business model patterns? *International Journal of Innovation Management*, 17(01), 1340003. doi:10.1142/S1363919613400033
- Alshawaaf, N., & Lee, S. H. (2021). Business model innovation through digitisation in social purpose organisations: A comparative analysis of Tate Modern and Pompidou Centre. *Journal of Business Research*, 125, 597–608. doi:10.1016/j.jbusres.2020.02.045
- Amit, R., & Zott, C. (2001). Value creation in e-business. *Strategic Management Journal*, 22(6-7), 493–520. doi:10.1002/mj.187

Making Smarter Museums Through New Technologies

Bae, W. K., Park, Y. S., Lim, J., Lee, D., Padilha, L. A., McDaniel, H., Robel, I., Lee, C., Pietryga, J. M., & Klimov, V. I. (2013). Controlling the influence of Auger recombination on the performance of quantum-dot light-emitting diodes. *Nature Communications*, 4(1), 1–8. doi:10.1038/ncomms3661 PMID:24157692

Balakrishna, C. (2012, September). Enabling technologies for smart city services and applications. In *2012 sixth international conference on next-generation mobile applications, services, and technologies* (pp. 223–227). IEEE. 10.1109/NGMAST.2012.51

Bogdan, R., & Taylor, S. J. (2013). The exhibition of humans with differences for amusement and profit. *Foundations*.

Carrozzino, M., & Bergamasco, M. (2010). Beyond virtual museums: Experiencing immersive virtual reality in real museums. *Journal of Cultural Heritage*, 11(4), 452–458. doi:10.1016/j.culher.2010.04.001

Demirkan, H., & Spohrer, J. (2015). T-shaped innovators: Identifying the right talent to support service innovation. *Research Technology Management*, 58(5), 12–15. doi:10.5437/08956308X5805007

Fenu, C., & Pittarello, F. (2018). Svevo tour: The design and the experimentation of an augmented reality application for engaging visitors of a literary museum. *International Journal of Human-Computer Studies*, 114, 20–35. doi:10.1016/j.ijhcs.2018.01.009

Gill, M. J. (2015). A phenomenology of feeling: Examining the experience of emotion in organizations. In *New ways of studying emotions in organizations*. Emerald Group Publishing Limited. doi:10.1108/S1746-979120150000011003

Hamidi, H., & Jahanshahifard, M. (2018). The role of the Internet of things in the improvement and expansion of business. *Journal of Organizational and End User Computing*, 30(3), 24–44. doi:10.4018/JOEUC.2018070102

He, Z., Wu, L., & Li, X. R. (2018). When art meets tech: The role of augmented reality in enhancing museum experiences and purchase intentions. *Tourism Management*, 68, 127–139. doi:10.1016/j.tourman.2018.03.003

Hewitt, E., & Stromberg, K. (2013). *Real and abstract analysis: a modern treatment of the theory of functions of a real variable*. Springer-Verlag.

Hollnagel, E., & Woods, D. D. (1983). Cognitive systems engineering: New wine in new bottles. *International Journal of Man-Machine Studies*, 18(6), 583–600. doi:10.1016/S0020-7373(83)80034-0

Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. *Journal of Service Research*, 21(2), 155–172. doi:10.1177/1094670517752459

Huang, M. H., & Rust, R. T. (2021). Engaged to a robot? The role of AI in service. *Journal of Service Research*, 24(1), 30–41. doi:10.1177/1094670520902266

Kaartemo, V., & Helkkula, A. (2018). A systematic review of artificial intelligence and robots in value co-creation: Current status and future research avenues. *Journal of Creating Value*, 4(2), 211–228. doi:10.1177/2394964318805625

Making Smarter Museums Through New Technologies

- Lanigan, R. L. (1979). The phenomenology of human communication. *Philosophy Today*, 23(1), 3–15. doi:10.5840/philtoday197923129
- Larivière, B., Bowen, D., Andreassen, T. W., Kunz, W., Sirianni, N. J., Voss, C., Wunderlich, N. V., & De Keyser, A. (2017). “Service Encounter 2.0”: An investigation into the roles of technology, employees and customers. *Journal of Business Research*, 79, 238–246. doi:10.1016/j.jbusres.2017.03.008
- Li, C., & Ghirardi, S. (2019). The role of collaboration in innovation at cultural and creative organisations. The case of the museum. *Museum Management and Curatorship*, 34(3), 273–289. doi:10.1080/09647775.2018.1520142
- Mele, C., & Russo-Spena, T. (2019). Innovation in sociomaterial practices: The case of IoE in the healthcare ecosystem. In *Handbook of Service Science* (Vol. 2, pp. 517–544). Springer. doi:10.1007/978-3-319-98512-1_23
- Merleau-Ponty, M. (1962). Un inédit de Maurice Merleau-Ponty. *Revue de Métaphysique et de Morale*, 67(4), 401–409.
- Moreno, L. D. R. (2018). *Museums and digital era: preserving art through databases*. Collection and Curation.
- Neuhofer, B., Buhalis, D., & Ladkin, A. (2015). Smart technologies for personalized experiences: A case study in the hospitality domain. *Electronic Markets*, 25(3), 243–254. doi:10.1007/12525-015-0182-1
- Ng, I. C., & Wakenshaw, S. Y. (2017). The Internet-of-Things: Review and research directions. *International Journal of Research in Marketing*, 34(1), 3–21. doi:10.1016/j.ijresmar.2016.11.003
- Ostrom, A. L., Fotheringham, D., & Bitner, M. J. (2019). Customer acceptance of AI in service encounters: understanding antecedents and consequences. In *Handbook of Service Science* (Vol. 2, pp. 77–103). Springer. doi:10.1007/978-3-319-98512-1_5
- Ozer, K., Sahin, M. A., & Cetin, G. (2022). Integrating Big Data to Smart Destination Heritage Management. In *Handbook of Research on Digital Communications, Internet of Things, and the Future of Cultural Tourism* (pp. 411–429). IGI Global. doi:10.4018/978-1-7998-8528-3.ch022
- Pallud, J., & Monod, E. (2010). User experience of museum technologies: The phenomenological scales. *European Journal of Information Systems*, 19(5), 562–580. doi:10.1057/ejis.2010.37
- Parry, R. (2005). Digital heritage and the rise of theory in museum computing. *Museum Management and Curatorship*, 20(4), 333–348. doi:10.1080/09647770500802004
- Piekkari, R., & Welch, C. (2018). The case study in management research: Beyond the positivist legacy of Eisenhardt and Yin. The SAGE handbook of qualitative business and management research methods, 345–358.
- Samara, D., Magnisalis, I., & Peristeras, V. (2020). Artificial intelligence and big data in tourism: A systematic literature review. *Journal of Hospitality and Tourism Technology*, 11(2), 343–367. doi:10.1108/JHTT-12-2018-0118

Making Smarter Museums Through New Technologies

Schaper, M. M., Santos, M., Malinverni, L., Berro, J. Z., & Pares, N. (2018). Learning about the past through situatedness, embodied exploration and digital augmentation of cultural heritage sites. *International Journal of Human-Computer Studies*, 114, 36–50. doi:10.1016/j.ijhcs.2018.01.003

Serravalle, F., Ferraris, A., Vrontis, D., Thrassou, A., & Christofi, M. (2019). Augmented reality in the tourism industry: A multi-stakeholder analysis of museums. *Tourism Management Perspectives*, 32, 100549. doi:10.1016/j.tmp.2019.07.002

Sezgin, A. C., & Karaman, E. E. (2022). The Internet of Things and Cultural Heritage. In *Handbook of Research on Digital Communications, Internet of Things, and the Future of Cultural Tourism* (pp. 85–102). IGI Global. doi:10.4018/978-1-7998-8528-3.ch005

Smith, S. B., Gill, C. A., Lunt, D. K., & Brooks, M. A. (2009). Regulation of fat and fatty acid composition in beef cattle. *Asian-Australasian Journal of Animal Sciences*, 22(9), 1225–1233. doi:10.5713/ajas.2009.r.10

Solima, L. (2016). Smart Museums. Sul prossimo avvento della Internet of Things e del dialogo tra gli oggetti nei luoghi della cultura [Smart Museums. On the coming advent of the Internet of Things and the dialogue among objects in places of culture]. *Sinergie Italian Journal of Management*, 34(Jan-Apr), 263–283.

Spohrer, J., & Banavar, G. (2015). Cognition as a service: An industry perspective. *AI Magazine*, 36(4), 71–86. doi:10.1609/aimag.v36i4.2618

Tom Dieck, M. C., Jung, T., & Han, D. I. (2016). Mapping requirements for the wearable smart glasses augmented reality museum application. *Journal of Hospitality and Tourism Technology*, 7(3), 230–253. doi:10.1108/JHTT-09-2015-0036

Trunfio, M., Jung, T., & Campana, S. (2021). Testing Mixed Reality Experiences and Visitor's Behaviours in a Heritage Museum. *Augmented Reality and Virtual Reality: New Trends in Immersive Technology*, 67.

Trunfio, M., Lucia, M. D., Campana, S., & Magnelli, A. (2020). Innovating the cultural heritage museum service model through virtual reality and augmented reality: The effects on the overall visitor experience and satisfaction. *Journal of Heritage Tourism*, 1–19.

Trunfio, M., Magnelli, A., Della Lucia, M., Verreschi, G., & Campana, S. (2018, June). Augmented and virtual reality in cultural heritage: Enhancing the visitor experience and satisfaction at the Area Pacis museum in Rome, Italy. In *8th Advances in Hospitality and Tourism Marketing and Management (AHTMM) conference* (p. 673). Academic Press.

Wang, B. (2021). Digital Design of Smart Museum Based on Artificial Intelligence. *Mobile Information Systems*.

Wang, Y., Jodoin, P. M., Porikli, F., Konrad, J., Benezeth, Y., & Ishwar, P. (2014). CDnet 2014: An expanded change detection benchmark dataset. In *Proceedings of the IEEE conference on computer vision and pattern recognition workshops* (pp. 387–394). 10.1109/CVPRW.2014.126

Making Smarter Museums Through New Technologies

Wirtz, J., Patterson, P. G., Kunz, W. H., Gruber, T., Lu, V. N., Paluch, S., & Martins, A. (2018). Brave new world: Service robots in the frontline. *Journal of Service Management*, 29(5), 907–931. doi:10.1108/JOSM-04-2018-0119

Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5). Sage.

**DICHIARAZIONE SOSTITUTIVA DI
CERTIFICAZIONE
(degli artt.46 del D.P.R. n.445 del 28/12/2000)**

**DICHIARAZIONE SOSTITUTIVA DELL'ATTO DI NOTORIETA'
(Art. 47 D.P.R. n. 445 del 28.12.2000)**

La sottoscritta, Fabiana Sepe nata il 09/10/1989 a Napoli e residente in Napoli alla via Talete di Mileto, 27 consapevole che chiunque rilascia dichiarazioni mendaci, forma atti falsi o ne fa uso è punito ai sensi del codice penale delle leggi speciali in materia,

DICHIARA

che nel contributo in volume "Making Smarter Museums Through New Technologies" (2022) con Marzullo M., In Handbook of Research on Museum Management in the Digital Era (pp. 75-98), IGI Global. DOI:10.4018/978-1-7998-9656-2.ch00, benché lo studio sia frutto dell'attività congiunta degli autori che ne condividono le impostazioni, le proposizioni della ricerca ed i risultati, è possibile attribuire in prevalenza alla sottoscritta i seguenti paragrafi:

- Introduction
- Methodology: the case study approach
- Case studies: smart practices in innovative museums
- EMMA: Electronic museums management & analytics: a smart integrating practice
- Theoretical and practical implications

La sottoscritta dichiara altresì ai sensi degli artt. 46, 47 e 76 D.P.R. 445/2000, sotto la sua responsabilità, che quanto su affermato corrisponde a verità, consapevole che le dichiarazioni mendaci sono punite ai sensi degli artt. 483, 495, 496 del codice penale e delle leggi speciali in materia.

La sottoscritta dichiara inoltre di essere informata, ai sensi del Decreto legislativo 30.6.2003, n.196, che i dati personali forniti con la presente richiesta saranno trattati, anche con strumenti informatici, esclusivamente nell'ambito del procedimento per il quale la presente dichiarazione viene resa.

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Napoli, 5 Giugno 2023

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Fabiana Sepe.