MANAGEMENT AND ACCESS STRATEGIES OF DIGITAL CULTURAL HERITAGE IN ITALIAN MUSEUMS: A COMPARATIVE STUDY

1. Introduction

Over the last decades, digital transformation has radically transformed how museums can document and manage information about their collections, both internally and externally. Digital Cultural Heritage has emerged in academic and policy circles as a new concept, which UNESCO (UNESCO, 2003) defines as resources of human knowledge or expression that include not only digital reproductions of the collection but also "texts, databases, still and moving images, audio, graphics, software and web pages, among a wide and growing range of formats". Museums are therefore faced with handling these digital cultural heritage resources, which is a critical challenge because it requires museums to become stewards of a large number of different types of data (Nuccio & Bertacchini, 2022). As these digitized resources increase and stratify over the years, a strong need emerges for a strategic vision to manage, preserve, and valorize these resources.

Several studies highlighted how museums provide physical access to less than 10% of their entire collection (Corona, 2023; Groskopf, 2016) ICCROM-UNESCO, 2011[1]. This is particularly critical considering that according to the new ICOM definition a museum is "an institution in the service of society that researches, collects, conserves, interprets **and exhibits tangible and intangible heritage**. **Open to the public**, **accessible** and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and **knowledge sharing."**(*ICOM*, 2022)

Following this statement, museums can achieve their mission by increasing digital access to their resources to sharing knowledge and be more open with a wider audience. The digitisation process by cultural institutions started in the 1990s and grew rapidly during the following decades and, nowadays, digitisation of heritage collections has become part of the key strategies to contribute to the knowledge economy, characterised by digital, sustainable and reliable access to cultural heritage (Navarrete Hernández, 2014)

The economic and management literature on the digitization of museums has extensively focused on aspects mainly related to new business models, emerging professional and organizational issues or innovation strategies (E. Bertacchini & Morando, 2013; Borowiecki & Navarrete, 2017; Lazzeretti & Sartori, 2016; Simone et al., 2021; Taormina & Baraldi, 2022), but less attention has been given to empirically analyzing how cultural institutions operationally manage and make accessible their various digital resources, what are the enabling and constraining factors when choosing digitisation strategies.

Once digitized, the problem that arises is how to enhancing the digital cultural heritage and allow access not only to the assets but also to the data describing the history of the objects, characterised by intangible and historical values (Lo Turco & Giovannini, 2020). According to Europeana ENUMERATE Core Survey 4, 82% of responding institutions have a digital collection or are engaged in digitisation activities. However, if the data on digitisation are positive, the data on accessibility indicate a poor online presence of cultural institutions. Overall institutions report that they have 51% of their descriptive metadata online for general use, while overall institutions report that they have 36% of their digitally reproduced and born-digital heritage collections online for general use (Europeana ENUMERATE Core Survey 4, 2017)[2]. The significant discrepancy between the two indicators highlights the problem of poor online accessibility of cultural heritage resources, which may not allow effective exploitation of what has been digitized. Poor accessibility limits online cultural

[1] ICCROM-UNESCO (2011). International Storage Survey 2011 Summary of results. Rome and Paris. https://www.iccrom.org/sites/default/files/ICCROM-UNESCO%20International%20Storage%20Survey%202011_en.pdf [accessed 04/01/2024]

[2] https://pro.europeana.eu/files/Europeana_Professional/Projects/Project_list/ENUMERATE/deliverables/DSI-2_Deliverable%20D4.4_Europeana_Report%20on%20ENUMERATE%20Core%20Survey%204.pdf

consumption that it's mainly related to the possibility of remote access, but also to academic research activity, creative reuse, educational use, commemorative use, personal enjoyment, preservation and commercial use (Booth et al., 2022; Borowiecki & Navarrete, 2017).

In this perspective, the paper aims to investigate what internal factors and external conditions influence museums' strategies and practices to manage access and reuse of their digital resources and data. In particular, the paper aims to answer the following research questions: How digital resource management practices differ according to the organizational characteristics of museums and the type of digital resources? What is the decision-making process behind adopting a given management and access policy of digital resources?

To answer these questions, we first propose an interpretative framework that combines a data management planning perspective to evaluate heritage organizations' choices with analytical dimensions related to the organizational and digital resource characteristics and apply it through a comparative multiple-case analysis of five Italian museums. The museums selected as case studies differ according to governance structure, collection type and accessibility of digital resources. The choice to focus the analysis on the Italian museum sector is motivated by several factors. Compared to other European contexts, the Italian museum sector is characterised by a high number and heterogeneity, where the largest and best known museums are followed by a long tail of smaller institutions whose needs, limitations and choices in relation to the management of and access to digital resources are less well known. At the same time, the Italian museum context is characterised by a strong component of public museums, both state-owned and owned by local authorities, a situation that makes it interesting to understand how public and private governance systems differ in resources and institutional incentives (given by the legal framework) in the choices of management and access to content related to digital collections.

The paper aims to contribute to the literature on the management of cultural heritage institutions by providing a novel interpretative framework based on data management planning perspective to empirically assess digital resource management and access practices in museums and contribute through a comparative analysis to a better understanding of the factors and conditions that influence such practices in different contexts. To our knowledge, only few studies have so far investigated in a systematic way the factors and conditions affecting museums' management and access practices, with a focus mainly on open access (Kelly, 2013; Estermann, 2014, 2016; Booth et al., 2022; Wallace, 2022). Our work is in line with this scholarship, aiming at extending it with a broader interpretative framework that tries to contextualize museums' access strategies of digital content within broader digital management perspective.

The paper is organized as follows: Section 2 presents the framework used to empirically analyze museums digital strategies; Section 3 briefly illustrates the Italian museum sector and its main patterns toward digital transformation; Section 4 describes the methodological approach, while Section 5 discusses the main evidence and findings.

2. Assessing digital cultural heritage practices: toward a data management planning perspective

To analyze museums' practices in managing and making accessible the content related to their digital digital collections we propose an interpretative framework made of two intertwined building blocks: i) a data management planning approach to study and disentangling key phases of the access and management strategy, ii) the identification of organizational factors and digital resource characteristics that can influence museums strategies and practices on the distinct phases of data management.

Data Management Planning (DMP) is a tool aimed to effectively manage data throughout its entire life cycle, from acquisition to dissemination. While DMP has been mainly used in the project and research field,

becoming a common feature of grant applications for pubblic and private agencies in the EU, the UK and the US(Briney et al., 2022; Lévesque & Doiron, 2021). While DMP has rarely been applied in the cultural context and in particular to the data that organisations generate, acquire and disseminate, such an approach may be particularly relevant for addressing the digital tranformation challenges faced by cultural heritage institutions. As shown in Figure 1, Data Management Planning considers four main phases.

The **acquisition phase** involves systematically gathering digital resources, including images, documents, videos, and other multimedia materials. It's essential to ensure comprehensive coverage of the museum's collections. Each item in the digital collection must be thoroughly documented, including metadata such as title, description, creator, date, and any relevant contextual information. The **storage phase** permits digital preservation and is critical for ensuring digital resources' long-term viability. This involves implementing strategies to prevent data loss due to technological obsolescence, hardware failure, or other risks. The **reuse phase** is about how these resources are made available through online platforms, APIs, or partnerships with other institutions. In this phase clear guidelines for data reuse, including licensing terms and copyright permissions, are essential to ensure compliance with legal and ethical standards. The **dissemination phase** includes the activities for promoting the digital collection and for improving the engagement and awareness of the museum's resources.

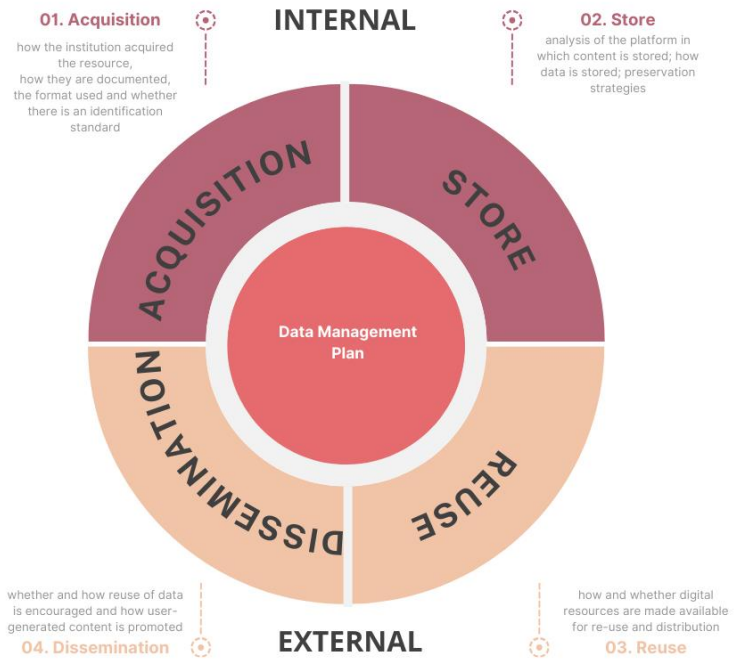


Figure 1 - The four phases of Data Management Planning

In the case of museums, the DMP approach can be applied to different types of digital information resources - texts, metadata, digital surrogates (2D and 3D copies of works) up to multimedia content - to have a fine-grained view on how these institutions produce, maintain and make these resources accessible to pursue the mission of producing and disseminating knowledge about their collections.

The second building block of our framework deals with identifying key factors and conditions that can affect the museums' digital practices over the different phases and type of resources. In navigating the complex landscape of digital resource management, we argue that the observed museums' practices depends on both the inherent characteristics of their organizational structure and the unique attributes of digital resources (Figure 2).

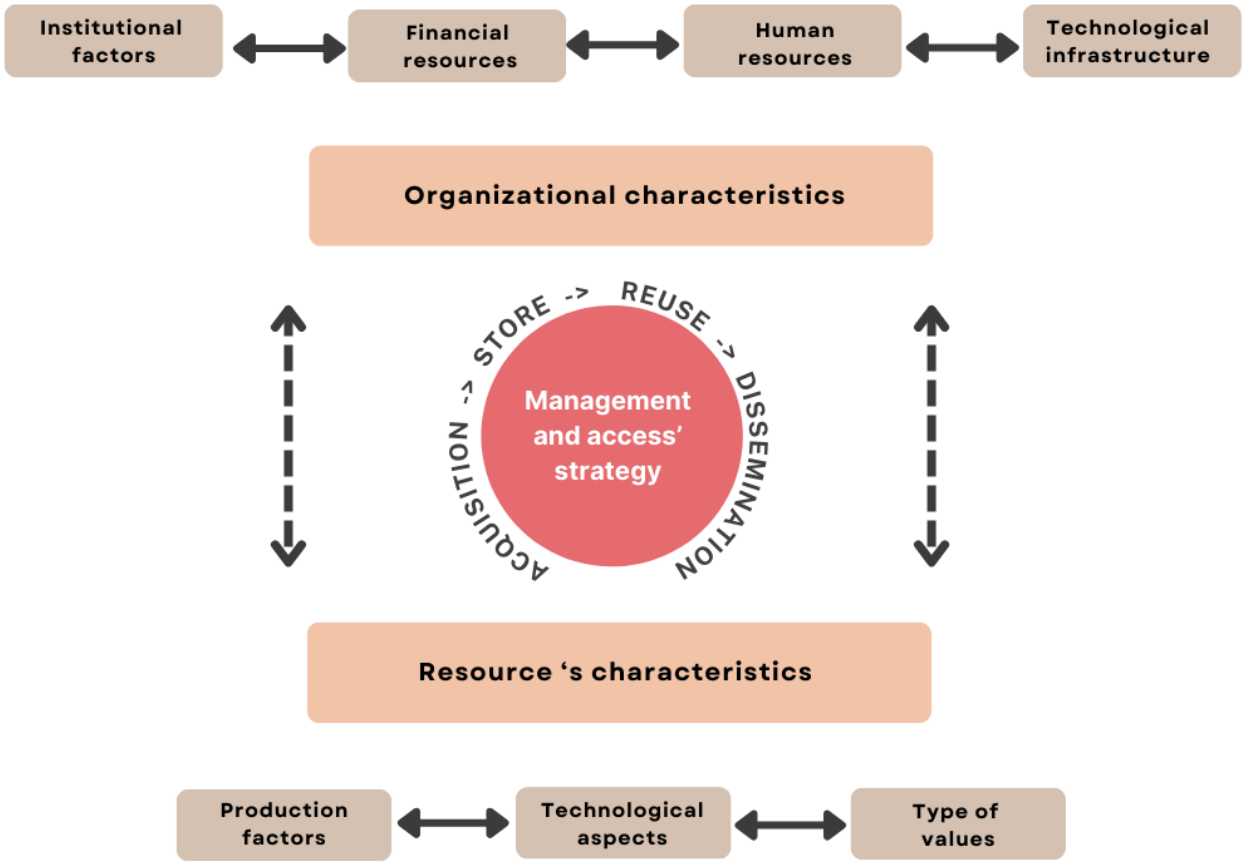


Figure2 - The framework

Organisational characteristics determine the ability of museums to navigate the challenges and opportunities set by the digital transformation while fulfilling their mission of education, conservation and public engagement. The main organizational characteristics identified in the literature are:

Human Resources: Digital transformation brings about major changes in human resources management, both internally through the emergence of novel professional roles and externally through heightened engagements with external consultants and services (Taormina & Baraldi, 2022). In particular, certain profiles become essential, such as digital strategy manager, digital collections curator, digital interactive experience developer and online community manager (Carvalho & Matos, 2018). These roles are intertwined with further more specialised emerging technical skills in digital innovation, including service design, data science and artificial intelligence (Candela, Sáez, et al., 2022).

Financial Resources: Limited budgets, competing priorities, and the high costs associated with digitization and digital infrastructure present significant challenges for museums seeking to expand their digital strategy, particularly in the face of economic and financial crises impacting the cultural sector (Borin & Donato, 2015; Corona, 2023; Vicente et al., 2012).

Institutional factors: Museums operate under different institutional structures, each influencing management and performance. The degree of operational autonomy may affect the decision to adopt ICT and thus knowledge, experience and digital innovation. In terms of governance, public museums directly controlled by government bodies tend to be more stagnant and conservative than private museums or public ones with management autonomy (E. E. Bertacchini et al., 2018; Cavalieri et al., 2023; Gombault et al., 2016;

Vicente et al., 2012). Similarly, national legal frameworks and cultural policies can influence, through the governance structure of museums, the incentives and constraints in adopting certain policies for access and reuse of their digital resources (Booth et al., 2022).

Technological Infrastracture: Digital technologies encompass a wide array of applications, platforms, and tools used for creating, storing, manipulating, retrieving, and transmitting information - including pictures, text, sounds, video - encoded in binary form. According to the maturity in the adoption of technologies, different types of heritage organisations can be distinguished, conservative, pragmatic and pioneering (Gombault et al., 2016). Conservative museums behave like late adopters who do not want to take any risks and are concerned about cost and resources. They adopt technology simply to display artifacts and to attract more assets. Pragmatic heritage organizations invest in more accessible and mainstream digital technologies, such as social media and interactive apps. The pioneers adopt technologies as tool for shaping the future of heritage and see adaptation as necessary as society evolves. At the same time, museums' decision in investing in technological infrastructure may prioritize different visions, either curator-oriented with a scientific and content perspective and visitor-oriented for entertainment and personalisation of knowledge (Kéfi & Pallud, 2011).

Jointly with the organizational characteristics, also the **economic and technical characteristics of digital resources** may influence the evaluation of costs and benefits in the choices that museums make in the different phases of management and access to digital contents. In the acquisition phase, different digital resources require different production factors which may be more or less available within the institution or require the use of external resources. The context of acquisition is influenced by various objectives, including preservation, restoration, and documentation. As a result, the techniques and technologies employed for acquisition vary depending on the specific application field and the characteristics of the cultural heritage objects being acquired. Indeed, the digital acquisition of the cultural resource is strongly influenced by the skills, financial resources and tools available. For example, if we consider the 3D acquisition of the object, the acquisition phase is made with a photogrammetry technique and after the model was retopologized to suite the visualization tool adopted to show data on a dedicated web-portal so very technical skills that are often found externally (Lo Turco & Giovannini, 2020), whereas a 2D acquisition of a cultural object can be done using a camera and in-house staff or it can be outsourced through collaborations with external actors such as Google Arts & Culture and online volunteers, e.s. Wikimedia (E. Bertacchini & Morando, 2013). Texts, for instance, are often produced in-house by curators who are able to present a series of narratives linked to other texts and resources, who scrupulously try to avoid an oversimplified interpretation of the history of objects through engagement with pluralistic narratives (Cameron, 2003).

Similarly, each type of digital resource produced by museums can express different **potential values** which also depend on how these resources are used by museums in dissemination and reuse choices. The texts can have an educational and research value, while the information from the collection catalogs mainly fulfills an informational and preservation value. Digital surrogates, on the one hand, can have a high educational and research value, but also economic value through commercial exploitation. While digitization incurs significant costs, revenue generation from digitized content may not always offset production costs (Terras, 2015). In this context, the need arises to reflect on strategies to extend and create different types of value from digital heritage collections. Digitisation creates added value to the physical collection, that can be economic and social (Pesce et al., 2019) , such as innovation in value creation and innovation in business model (Nuccio & Bertacchini, 2022). For example, high-resolution images can be used to attract sponsorships or funding for special projects or exhibitions, used to create new digital arts or used in the research field; texts and documents can serve as resources for academic and scientific research, attracting funding for study or exploration projects or can start collaboration initiatives with other academic or cultural institutions, leading to shared funding or joint research opportunities; recordings of special events or performances can be offered as part of exclusive experience packages for museum supporters or fundraising events.

To take advantage of these different values, museums can choose different models of accessing and reusing digital resources, including online access, proprietary licensing, open licensing, and user-generated content (E. Bertacchini & Morando, 2013). The four models differ on the type of control exerted by institutions over their collections and the appropriation strategies through which they capture the economic value generated by the production and dissemination of digital content related to theartworks. Online access and proprietary licensing models are based mainly on exclusive control over the resources for both commercial and non-commercial uses. These museums, for example, can derive economic value from the sale of images, which become a business asset, and they can control the reuse of this. In contrast, open-licensing and user-generation models tend to relinquish control in favour of serendipitous access to and reuse of cultural content. Institutions consider non-commercial use, agree not to do resource tracking, in return for social sharing to enhance outreach and engagement (Kelly, 2013).

3. Italian Museums amid the digital transformation

The Italian cultural heritage is often considered one of the largest and most diversified in the world, characterized by a wide and heterogeneous set of museums and heritage organizations, which differ as far as type of collection, geographical location, institutional features and number of visitors are concerned. According to the Italian museum census, about 5,000 museums and similar institutions are active in Italy, made up of 3,882 museums, galleries or collections (80.5%), 630 monuments and monumental buildings (12.8%), 327 archaeological and historical parks (6.7%). From an institutional viewpoint, the ownership structure of the heritage institutions is mostly governmental (63.4%), at the level of State, Regions, local public administrations (provinces and municipalities), public schools and universities. There is however a great heterogeneity as regards the size and characteristics of heritage institutions depending on ownership and control by public sector authorities. While most public museums and cultural institutions are owned by local government and municipal authorities, only 448 are owned and managed at the state level. This group which constitute less than 10% of the total, alone attracts about 40% of visitors as it includes some of the most internationally known museums, monuments and archeological parks that attract a large flow of visitors, like the Galleria degli Uffizi, Pantheon, the Flavian Amphitheatre (Colosseum), the Archaeological Area of Pompeii and the Museum and Park of Capodimonte. At the same time, besides the main attractors, is a large number of less visited state-owned museums and heritage institutions, whose management and conservation are under central government control due to the national significance of their cultural heritage (E. Bertacchini et al., 2021).

As in other European countries, the cultural heritage sector in Italy is facing the challenge of digital transformation, but, at least until the Covid-19 pandemic, digitization of cultural heritage in Italy has been relatively limited or characterized by fragmented initiatives. According to data from the 2019 museum census, only 45% of museums had undertaken digitization activities of their collections, consisting in many cases only of digital catalogues and inventories. While more than half (68%) of Italian museums have a digital presence through social media platforms only a third, or 29%, provide digital catalogues of their heritage collections, including photos, videos, and databases, allowing audiences to explore their holdings remotely. Furthermore, only 19% of museums, and mainly the most important ones, provide virtual tours online, offering immersive experiences of their exhibitions and spaces.

In 2022, and mainly in response to the COVID-19 pandemic, recent reforms by the Italian Ministry of Culture has been to strengthen the digital infrastructure by coordinating activities within the museum and cultural heritage sector and by giving centrality to digital technologies to further stimulate the transformation of public museums in terms of engagement and relationship with the public (Agostino et al., 2020). In particular, a national plan for digitizing cultural heritage has been launched by the Italian Ministry of Culture, which

envisages more investments and a more unified strategy through the launch of National Digital Library initiative, but whose results have yet to be realized.

From another point of view, the national legal framework outlined by the Italian Code Cultural Heritage and Landscape(CCHL) - the legislation regulating cultural heritage in Italy - points to a highly problematic scenario. Even though in its Constitution the commitment to cultural promotion and enjoyment, the Italian legal system exhibits conservative proprietary tendencies regarding the State's control over the re-uses of its digital cultural heritage managed by public museums and institutions (Dore & Prioria, 2024). According to Art. 107, reproductions of cultural goods are generally permitted, subject to compliance with certain limits set out in subsequent articles, other legal texts, and regulations adopted by the various administrations and, copyright, which is usually expired for cultural heritage good. Concession fees and royalties are applied to reproductions of cultural goods, which are determined by the authority that delivers the goods and must be paid in advance, the criteria for which are set out in Article 108 (Aliprandi, 2022; Giardini, 2023; Modolo, 2021). This limitation places limits on initiatives to promote and disseminate Italy's cultural heritage on a global scale, hindering the exchange of knowledge. In fact, the usefulness of the digital resource lies first and foremost in the potential for sharing, which allows for increasing instances of re-use, the user base and the value recognised by the community for cultural heritage. This situation creates a gatekeeping situation for public museums that hinders on innovative approaches, such as open access approaches, place specific restrictions on the commercial re-use of images of public cultural property, but without leading to a clear understanding of whether these restrictions foster or hinder the potential development of Italy's digital cultural heritage or enable some form of profitability for Italian cultural institutions.

4. Methodotological approach

A multiple case study approach was selected to investigate the digital management and access' practices developed by Italian museums. The decision to use the comparative multiple-case analysis as method was motivated by the fact that the aim of the research was to empirically explain 'how' and 'why' Italian museums nowdays deal with strategies for accessing and managing their resources (Yin, 2018).

Five Italian museums were selected as case studies taking into account differences in governance, collection type, number of visitors and number of total staff members (table 1).

The Museo Egizio is one of the most important museums dedicated to ancient Egypt. Located in the center of Turin, in the north west of Italy, it houses an extraordinary collection of Egyptian artifacts covering a time span of over 4,000 years, from prehistory to the Coptic era. The Musei Civici Reggio Emilia are the museum system of the city of Reggio Emilia, located in north east of Italy. It is a system of collections, historical sites, and exhibition halls that have developed over time, where the memories of nature, archaeology, art, and history of the city and the entire provincial territory are documented and enhanced. The Museo Civico Modena, located in the historic center of Modena, also in the north east of Italy, tells the history and culture of the city with its collections of archaeology, ethnology, art and artistic craftsmanship, scientific and musical instruments. The Museo delle Marionette - located in the south of Italy - is one of the most important museums dedicated to puppets and puppet theatre. It preserves a collection of over 5,000 works, including the largest collection of puppets from Catania, Palermo, and Naples, as well as animated figures from around the world, including those used in other traditions recognized by UNESCO. The Ecomuseo delle Grigne - founded in 2008 - collects, preserves, and enhances the material, immaterial, and landscape heritage of the Grigne, located in North West of Italy, focusing on the relationship between man and the mountain that characterizes its territory.

Since the research aims to identify patterns in Italian models, the case studies represent the diversity that characterizes Italian museums system. The 5 case studies represent three categories of museums: small (Ecomuseo delle Grigne), medium (Museo Civico di Modena and Museo delle Marionette), and large (Musei Civici di Reggio Emilia and Museo Egizio), both in terms of available human resources and the number of people they are able to attract on-site. Furthermore, among the case studies, only the Museo Egizio has

declared having a member of staff responsible for IT services (website, digitization, ICT, multimedia, etc.) exclusively for its own museum, while the others share the employee with other institutions. Another determining characteristic, as we have already seen, is governance. Museums can be both private and public and can be managed by a variety of entities, such as foundations, recognized associations, or governmental bodies.

Regarding the type of collection, each museum has a particular focus, ranging from archaeology (Museo Egizio) to ethnography and anthropology (Museo delle Marionette) to natural history and natural sciences (Ecomuseo delle Grigne) and miscellaneous (Musei Civici di Reggio Emilia and Museo Civico di Modena). Various types of cultural objects can require different digitalization approaches, and probably they need a different audience orientation.

The comparative analysis allows us to investigate different patterns of digital resources management, different needs and motivations behind the access policy adopted by museums, and how management and access processes are implemented.

Table 1 Summary of the characteristics of the 5 case study museums

Museum	Macro-region	Type of Governance	Type of collection	N. of visitors (ISTAT 2019)	N. of staff members (ISTAT, 2021)
Museo Egizio (Turin)	North-West	Private - managed by a Foundation	Archaeology	> 850,000	46
Ecomuseo delle Grigne (Esinio Lario, Lecco)	North-West	Public Non-State - owned by local governament but managed by Non-Recognised Association	Natural history and natural sciences	<1,000	4 (volunteers)
Museo Civico Modena	North-East	Public Non-State - owned and managed by local government	Miscellaneous	10,000 - 100,000	11
Musei Civici Reggio Emilia	North-East	Public Non-State - owned and managed by local government	Miscellaneous	100,000 - 500,000	46
Museo della Marionette	South - Islands	Private - owned and managed by recognised association	Ethnography and anthropology	10,000 - 100,000	6

Research data are collected from two sources: i) a Data Management Plan (DMP) of the content and resources available on the museums' public digital channels and ii) semi-structured interviews with museum staff. Data collection was conducted between May 2023 and November 2023.

The museum's data were analyzed in Data Management Plan's four phases: acquisition (i.e. data collection and documentation), storage (how resources are preserved and stored), reuse (data sharing and reuse), and dissemination. The Data Management Plan has been compiled for each case study with the collaboration of the museum representatives involved. This tool has enabled an overview of the accessibility practices of museums and the identification of any gaps between declared policies and actual implementation.

The semi-structured interviews offer a comprehensive and contextualized understanding of the topics addressed and they have allowed for an in-depth exploration of the opinions, perceptions, and experiences of museum experts. The semi-structured interviews were conducted in two sessions. The first aimed to retrospectively explore how the institution developed its digitization processes over time, with particular attention to organizational aspects (such as when and how it started, who was responsible, if there is a digital strategy and what it focuses on, if digitization was conducted internally or externally). The second session of interviews aimed to investigate the museum's decision-making process regarding the policy implemented for accessing its digital content, considering resource availability, motivations, and obstacles. Engaging museum experts through semi-structured interviews also contributed to creating a participatory environment.

The analysis of the data collected then had a first stage of analysing the completeness and consistency of the DMPs. The key elements of the DMPs were used to understand the museums' data management strategies and identify common trends, strengths and areas for improvement. The semi-structured interviews were transcribed and a thematic analysis approach was used to identify recurring patterns in the participants' responses. This phase was used to explore the differences and similarities between the responses of the different museum's interviewees and to look for links between the interview and the DMP data to gain a comprehensive understanding of the strategies adopted.

5. (Preliminary) Results and discussion

The analysis identified four thematic axes related to the management of the digitisation process of resources and how these are made accessible, in which enabling factors and obstacles are highlighted:

(1) project-approach management

For all five museum interviewed, the phase of acquisition of digital resources is a long process that has lasted for about twenty years. In these years the institutions have managed and dealt with numbers of digitization projects, which have become layered over time. Project-approach management is common to all five museums, finding no substantial differences in the characteristics. Museums, as in the absence of a stated digital strategy, are forced to approach digitization by frammenting in projects, planning and implementing a series of activities to achieve a given goal through the use of limited time and resources. Underlying management by project is a desire to make up for the lack of financial and human resources to meet digital challenges. In fact, the projects are externally funded, such as by local authorities,bank foundations, associations such as Wikimedia,which often offer not only funding but also practical support. In addition, this type of management offers the possibility of managing the complexity and variety of museum collections-especially in museums that have miscellaneous collections-for example, focusing each project on a specific section of the collection at a time.

This project-based approach applied to museums has both positive and negative effects. On the one hand, in fact, it allows them to have a clear objective, to be flexible, and to be proactive toward external projects/proposition. On the other it creates fragmentation that fails which limits an overall vision for museums. The museums interviewed stated the need to reduce this fragmentation and try to connect everything digitized all at once. To address this, three of the five museums have initiated projects with the aim of bringing together what has been done so far and creating an interoperable digital environment. For example, the Museo Civico Modena with the Open Gate project, funded by the superintendency, and the project of the Museo delle Marionette through European funding[3]. An additional negative effect noted in public governance museums and small museums is that project outputs are not managed and maintained over time due to shortage of human resources and time. This nullifies the investments made, both in terms

[3] Next Generation EU attraverso i fondi destinati al PNRR – Piano Nazionale di Ripresa e Resilienza, TOCC (Transizione Ecologica Organismi Culturali e Creativi

of economic and human resources, as digitally unpreserved products are less attractive and not update, having a negative impact on the museum.

These needs for clarity and project curation have also influenced their own institutional structure in the case of the *Museo Egizio*, which stated that it had established a digital transition committee and intended to include the figure of the Data Manager, and the *Museo Civico Modena*, which included the figure of the Website, Communication and European Projects Manager.

(2) Curating the datafication

As previously discussed, digitization began in the 2000s and was therefore a long process in which several activities took place. The approach to datification depends mainly on the type of assets, skills operating, and funds availability, both during the acquisition and subsequent storage phase.

Texts appear to be the easiest resources to produce, as they are mostly generated and managed internally by expert museum staff, such as curators, and do not require high financial resources. The production of texts such as catalogues, online text, research publications is part of the museum's public mission - based on activities of research, collection, preservation, interpretation, and exhibition. The strong link to its mission and internal production means that the governance and museum's size are significant features ,except for the *Ecomuseo delle Grigne* whose management is given to an association community-oriented and not having staff, they have to rely on external collaborators or volunteers.

Digital surrogates such as images, audio, and 3D models are more complex to acquire because they often need external collaboration and specific equipment. The motivations behind the creation of these digital surrogates are different: the main ones are preservation, enhancement, communication, and research. For example, the *Museo delle Marionette* digitized its ethnographic collection for preservation reasons, due to the high perishability of audio reel materials that were in danger of being lost due to obsolescence. In the case public museums, *Musei Civici Modena* and the *Musei Civici Reggio Emilia*, the predominant motivation is those of marketing campaigns,for catalogs or exhibitions. An isolated case is the Museo Egizio, which has produced numerous resources and data through the archaeometry approach, producing numerous laboratory analyses of materials on cultural property and enhancing, through digital outputs, the narrative of the invisible, which later resulted also in the virtual tour Archaeology Invisible. For these types of resources the possibility of acquiring resources internally or externally is influenced not only by the size of the museum, but also by governance. The *Museo Egizio* is the only one that has the in-house human and technical resources to produce, having a photographer who is also in charge of 3D models created in-house, while public small to medium museums digitize externally whenever possible. Due to high costs, public museums run by public agencies are the ones that struggle to manage - beyond the marketing campaigns mentioned before- the acquisition and for images for example, often relying on temporary staff such as volunteers to digitize with low quality tools, such as telephones

Once digitized, storage occurs through backups, which can be on fixed media or online servers. These activities seems to be influenced by governance. Among the museums interviewed, the private ones stated that they have a strategy, while the public ones run by the municipality claimed that this activity is managed by other departments in the institution. Finally, the *Ecomuseo delle Grigne* stated that it needs to improve its backup because it is simply done on drive or wikimedia, which being collaborative could easily be modified. The governance also affect also the preservation\exhibition online. In fact, being a public museum places constraints on the platforms to be used, which are often designed by local entities such as municipalities or regions or state. In the case of municipal public museums, the constraint is extended to the entire digital ecosystem, using weaponized digital tools compared to the rest of the institution and thus leaving little independence on which digitalu tools to use. On the other hand, private museums have more freedom on

which platforms to use, being able to create ones suited to their own collection, if funding is available. In all the museums interviewed, there is a multichannel nature in online publication, in which digitized collections are present on different channels, such as Wikimedia, Google art&culture, platforms created by territorial entities, platforms created ad hoc, etc.

(3) Sharing the knowledge: the copyright status of the collections.

The comparison between the interviews and what the DMP stated highlights a discrepancy between the stated policy of digital accessibility and the actual implementation in practice, emphasizing difficulties in communicating outwardly.

Although all respondents appear to be aware of European and national policies on public domain and copyright for reproductions of cultural heritage, they stated that they find it difficult to manage the rights of their acquired digital resources and to stay up-to-date with new directives. In fact, in terms of managing the reuse phase and digital rights management, the situation is very complex. The difficulty for institutions arises mainly from two factors: the lack of skills and comprehensive knowledge of specific legal tools in the museum staff and the different type of resources that have to manage (often with diverse ownership).

Institutions have in fact stated that they do not have specialized staff on these issues, the only exception being the Ecomuseo delle Grigne, which has been linked to Wikimedia projects since its early years and has been among the promoters of Creative Commons licenses. However, museum staff of all 5 museums is aware of this issue and in recent years they have initiated projects and collaborations to train on the subject. For example, a training course done by the Museo Civico Modena with ICOM Italia on the web communication, also extended to other museums in the region, including the Reggio Emilia Museum, or the agreement between Creative Commons, Wikimedia Italia and the Egyptian Museum.

The variety of cultural objects in collections and digital resources is an additional obstacle. Not all assets are the same, for example, some may be in PD, others under copyright, and still others may be state-owned (such as archaeological assets). This variety increases complexity and stress for cultural institutions. Coping with this would require analysis and/or consultation, which takes time that employees often do not have.

It should be pointed out that in some situations platforms become gatekeepers of digital resources,as for example the catalogues with text and images of the Museo Civico Modena that on the regional platform, Patern, are under the CC BY-SA-NC license instead of the chosen CC BY-SA, therefore under a more restrictive license, and difficult/slow to change because of the way public administration acts. Another example is images and text of the Musei Civici Reggio Emilia on Google Arts & Culture where the licences are not specified. To cope with this, one possible strategy might be to structure the subdivision by subcategories of the collection, as in the case of the *Museo Egizio*, which started with images from the collection in cc by and cc0 for archival photographs. another solution is that of the *Ecomuseo delle Grigne*, which ,in order to simplify the process, has chosen to use a default license that is applied to all of its content and to maintain the license in derivative works as well.

License communication in the online environment is extremely important because it enables success with potential online users, and so having an impact online. In contrast, the quasi-absence of licenses accompanying resources makes it difficult to indicate to online users what is possible, leaving them uninformed or in doubt.

(4) The challenges of decision making

These five museums, although with different specificities, share a common vision regarding the accessibility of cultural heritage. All five base their policies on the idea that cultural heritage should be accessible to all, adopting digital content accessibility policies. The decision-making processes behind this policy are influenced by a number of factors, including museum leadership, practical limitations such as lack of staff and financial resources, and a growing internal awareness of the potential of the digital collection, consolidated since covid19. Despite the challenges, there is an unwavering commitment to change and a willingness to develop new partnerships and services to facilitate research and enjoyment of cultural heritage.

"cultural heritage belongs to everyone" The Museo Egizio bases its policy on being primarily a research attraction, in which outputs are to be made public to all. This accessibility policy is on the one hand dictated by the museum's identity as an international research center, and on the other by its leadership. Although this vision initially manifested itself informally, it is now more structured and ordered thanks to the efforts of the management, which has strongly advocated the formation of digital literacy, including through the formation of committees specializing in mission and vision, the ethical aspect of activities from research to dissemination, and the digital transition
The strength of this decision making is inherent in the independence of their governance. In fact, the foundation has full freedom over management and enhancement to promote knowledge of the collection, which is complemented by excellent management made of informed choices.
This decision making involves all museum staff, although there is no specific coordination, and in the future it is planned to include a responsible or coordinating position, especially to manage relationships with partners. Determinants are expectations about new opportunities for services, projects, and partnerships that might emerge, while not a hindrance, concerns about potential misuse or abuse of data, the museum believes that openness and sharing are critical to the public and cultural mission, and accepting the museological shift of this choice.

"Everything that is public must become public again" The Museo delle Marionette declares that its policy is on the effort to put content online with the goal of making its holdings accessible to all. The rationale is that digitization activities are often funded by public entities, so sharing is seen as a return to the community. This decision is also motivated by the need to bring internal order and enhance the collections, both physical and digital, and then make the material usable and scholarly by the public. However, the process is affected by practical limitations, such as the availability of staff and financial resources. The decision-making process to make content available online has been accelerated by the pandemic, which has highlighted the need to find new ways to use and enhance the material. The museum has positive expectations regarding the change in access policy, with the hope of developing new partnerships and projects that encourage research and enjoyment of their heritage.

"Open by default" The Ecomuseo delle Grigne bases its decision making toward accessibility and open access of digital content with a clear and shared vision, exploiting synergies with Wikimedia. The main motivation behind this choice was interoperability and the possibility of enriching cultural heritage with input from a large online community. The decision-making process to make content available online was driven by a sensitivity to open access on the part of staff and contributors. The model is declared open access and was seen not only as a way to increase the impact and visibility of content, but also as an opportunity to actively engage the public in the creation and enrichment of museum material. This led to the conscious decision to adopt the CC BY-SA license as the default that guides all management of the institution and is applied to all association content, thus ensuring a consistent and transparent approach to open data. Adherence to the open access model was supported by a shared vision of the museum as a common good of the local and global community. The policy shift toward open access was driven by a diverse group of people, including association staff, the collaborative network, and external experts sensitive to these issues. The aim is to

ensure the sustainability of the project in the medium to long term, despite staff turnover characterized by volunteers or external collaborators.

"An expanding museum." The current approach of Museo Civico Modena focuses on the museum's digital expansion, with the goal of making its content accessible through a series of online projects and platforms. The decision-making process to adopt a more digitally accessible was driven by the will of the museum staff and management- leadership. The transition to a more open model is underway and includes the adoption of Creative Commons licensing to make resources available to the public without copyright restrictions, allowing for broad reuse and sharing while meeting a civic commitment, thus being public. A strength of decision making is an increased awareness of the benefits of an open access model and collaboration with outside experts and museums. Expectations regarding access policy change include the hope of creating new partnerships and services, as well as improving the visibility and accessibility of the museum's cultural heritage. Their change is supported by the commitment and continuous training.

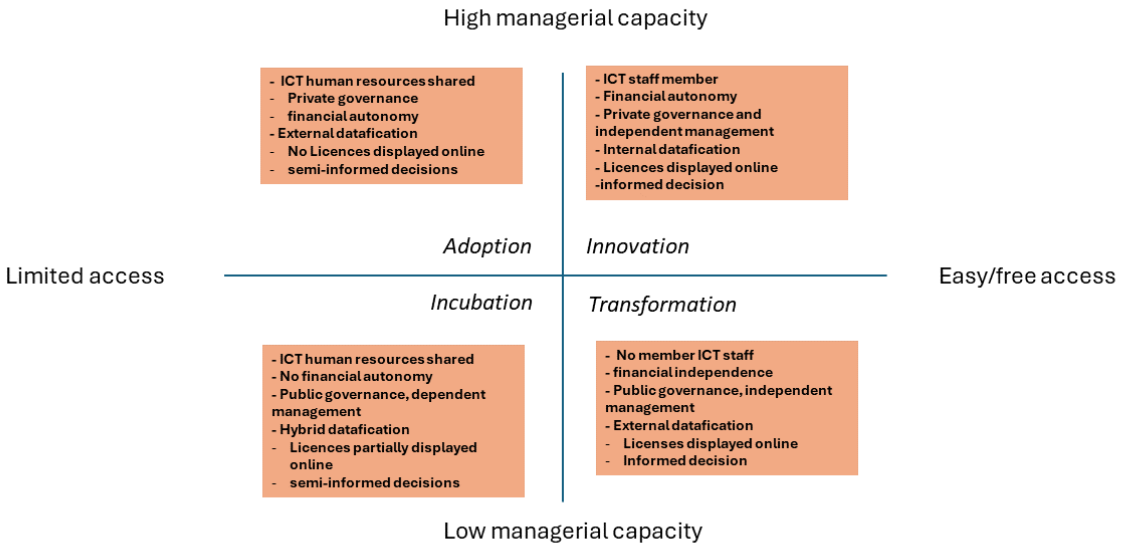
"Newer, bigger, more museum ... also online" The idea that stimulated the change is to be, on the one hand, more accessible in order to facilitate research and also to gain visibility, but on the other hand also to supplant all the activities that are a commitment for the staff-laden institution. The decision-making process is long and complicated due to the absence of a well-defined strategic solution to increase accessibility, highlighting the difficulties related to the presence of multiple institutions in the municipality, each with different rates and separate policies. This fragmentation, in fact, has complicated decision-making and contributed to the lag in awareness about the importance of digital tools. In the decision-making process for increasing the access, the role of management and the challenges encountered were highlighted, such as the lack of in-depth consideration of the fee schedule issue and the restrictions imposed by the superintendency regarding the sharing of archaeological materials. Decision making was influenced by a growing awareness within the staff, especially after the experience of the lockdown due to the Covid-19 pandemic, which highlighted the importance of digital tools for the enjoyment of cultural heritage.

To summarise, the process of decision making is simpler and faster in the case of large private museums, this is in fact favored by greater independence in taking decision and human resource management, while it is severely slowed down in public museums with municipal management, which must comply with an administrative process and has no staff necessary for a decisive breakthrough that often depends on the figure of the director. Indeed, for all the museums involved, in the decision making process, there emerges a need for external actors who can support and provide expertise outside the museum staff. This is an effect to make up for internal weaknesses and highlights the need for more initiatives to support it.

(5) *The four empowerment access models*

Reflecting their assets, policies, and institutional priorities, museums can be distinguished in terms of resources' access to collections (limited and free) and management capacity (high or low). The combination of these two factors determines different approaches to the management and access of digital resources.

Access is characterized by a willingness to change toward policies to democratize online audiences. For this purpose, museum offer different levels of access to their collections through differentiating resources ranging from online texts to the ability to explore cultural good in 3D. Making these resources easily accessible to the public through digital platforms, however, puts stress on museums, which must adapt both internally and externally. Management capacity represents the ability to manage the process, and is made by greater financial independence that enables them to invest in appropriate technology and collection development programs, presence of skilled staff in areas such as collection management or ICT, the presence of innovative collection management technologies and infrastructure, and finally having clear policies and well-defined strategies for collections management and digital access, that are able to ensure greater consistency and transparency in their practices.



The intersection of these two factors makes it possible to identify 4 empowerment models for the management and access of digital resources, from incubation to innovation.

In the *incubation model*, technologies and practices related to managing and accessing digital resources are absent or still in the initial development stage. Museums are exploring new ideas and experimenting with solutions to address accessibility, taking into account their limitations, such as lack of financial autonomy, public governance, and the absence of a dedicated ict staff member. Museums start small pilot projects or internal initiatives to assess the opportunities associated with new approaches to enhance visitor engagement and accessibility to museum resources. In *the adoption model*, the museum identifies successful practices and technologies and start to integrate them slowly into its operations, due to greater managerial power. This phase involve implementing specific tools and platforms to enhance accessibility to digital resources and optimize capacity management. The focus is on making museum resources more accessible to diverse audiences. The *transformation model oc*curs when, through more informed decisions, museums review and redesign their operating models to maximize the benefits of improved access to digital resources. Despite limitations in management capabilities, new business models and partnerships can emerge to take full advantage of the opportunities offered by digital transformation. In the *innovation model,* the change drives the museum's approach to digital management and access. Museum are able to fully leverage digital resources and internal management capabilities to develop new services and, also, business models. The museum continually explores new possibilities to push the boundaries of digital engagement and enhance accessibility for all visitors.

CONCLUSION

This research highlighted what factors are limiting digital collections management and access strategies in the Italian context. In particular, the analysis, based on the one hand with an institution-oriented approach and on the other with a resource-oriented approach, showed that despite a strategic need, museums are slowed down in adopting projects that would improve accessibility: perceived lack of vision , lack of budget, lack of expertise, slow decision-making, content problems, and difficulties in maintaining digital resources. In particular, four patterns were identified: incubation, adoption, trasformation and innovation. these models differ in the degree of capacity management of the institution and the degree of accessibility of its resources.

Theoretical implications

The research makes a significant contribution to the field of digital resource management. It provides a framework that identifies all the characteristics that influence strategies for accessibility and management of digital resources, on the one hand considering the characteristics of the resource itself, and on the other hand of the institutions. Through the analysis of case studies, it was possible to identify blocking and challenging phenomena influencing strategies, delineating the 4 empowering phases that characterise the transition from no-strategy to innovation.

Practical implications

The data management plan is a tool that comes right from the field of project planning and research; its implementation in museum organizations of digital resources-from acquisition to dissemination-could improve management. A data management plan approach can help cultural institutions to manage the digitization of resources and to future sharing, giving them a tool to have strategic management.

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