

Essay

Museums and the Post-Digital: Revisiting Challenges in the Digital Transformation of Museums

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Abstract: This paper considers the digital transformation of museums and, particularly, the challenges museum professionals face today in the implementation of digital practices. The exploration of the challenges that museum professionals need to address, and the values associated with the “digital” are critical in the context of current and rapid sociocultural and technological changes. This paper reviews a diverse typology of resources—including project reports and deliverables, qualitative and quantitative surveys, academic articles, edited volumes, and chapters—relevant to the implementation of digital practices in the “backstage of museums.” This essay will show that, although digital technologies have acquired a normative presence, organisational and technical challenges in the “backstage” of museums pose systemic problems in their digital transformation. These are systemic problems related to skills and knowledge, and human and financial resource deficits, which result in museum professionals exerting constant effort to keep up with the rapid changes in digital technologies with limited resources at hand and the risks of technological obsolescence and abandonment always present. Situated within the emerging literature advocating for a holistic, ethical, and sustainable digital transformation of museums, this paper draws attention to the implications of the digitalisation of museums in the transition to a responsible and sustainable digital future in a European context. It argues that a relational understanding of sustainability and ethics can be a pivotal first step towards the formation of a digitally purposeful museum in the post-digital era.

Keywords: cultural heritage; museums; digital transformation; museum professionals



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1. Introduction

In the context of the ReInHerit project (Id No. 101004545), funded by the European Commission’s Horizon 2020 research and innovation programme, a series of focus group interviews with 38 professionals from 10 European countries was conducted in March 2022 to investigate digital transformation in small- and medium-sized museums in Europe [1]. The aim was to explore the barriers, opportunities, and motivations for adopting digital technologies in museums and the value that they bring [1]. The participants were professionals with different types of expertise (ICT, curation, museum education, public officers, academic researchers) working in or collaborating with different types of museums. During the focus group interviews, the participants discussed at great length the challenges they faced during the implementation of digital technologies in museums they either worked in as permanent or contractual personnel or as external collaborators [1]. However, the results of the ReInHerit focus group interviews represent the perceptions of a small cross-section of professionals in Europe, and their experiences are particular to their educational and social contexts. Prompted by this, the aim of this paper is to critically reflect on the digital transformation of museums by reviewing a diverse typology of resources. In doing so, it draws attention to the challenges museum professionals face during the implementation of digital activities and to their implications in the transition to a responsible and sustainable digital future in a European context.

The term “digital transformation” is used in different ways by different sectors [2], and for this reason, this paper follows the terminology on digital transformation as proposed by Europeana. The independent charity Culture24 [3] was commissioned by Europeana as part of its capacity-building project to draft the “Digital Transformation in the Time of COVID-19” workshop. Building on these findings, Europeana proposes a definition for digital transformation, the summary of which is:

“[Digital transformation is] both the process and the result of using digital technology to transform how an organization operates and delivers value. It helps an organization to thrive, fulfil its mission and meet the needs of its stakeholders. It enables cultural heritage institutions to contribute to the transformation of a sector powered by digital and a Europe powered by culture.” [4]

This is seen as the contemporary condition of museums, as museums have entered their post-digital era where digital technologies have acquired a “normative presence” [5] (p. 2): (a) in the institution’s operations, such as collection management, conservation, communication with audiences through social media and websites, educational activities, exhibitions, and ticketing; (b) in the ways museum professionals understand their relationships with their audiences; and (c) in how visitors experience cultural heritage [6–11]. It is important to note that the use and typology of technology vary greatly between institutions due to their specific organisational, infrastructural, and policy contexts that condition their digital capacity [12–14]. This points to Francesca Taormina and Sara Bonini Baraldi’s [15] proposal that digital transformation, or the digitalisation, of museums requires a multidimensional analytical approach that looks at museums from an operational, organisational, and strategic perspective. Similarly, Maria Shehade and Theopisti Stylianou Lambert [7] note that the perceptions and experiences of museum professionals with emerging technologies need to be explored in more depth to contribute to the current literature [16,17]. It is important, in other words, to look “behind the scenes” of museums [18] because they are working places for professionals to engage in “everyday organizational processes and administrative practices and inhabit the workplace with all its complexities and contradictions” [19] (p. 112). Drawing from this literature, this paper explores digital transformation in the current post-digital circumstance by looking at the “backstage” of museums with a specific focus on the challenges museum professionals need to address.

2. Materials and Methods: Reviewing the Challenges in the Digital Transformation of Museums

2.1. Museums and Digital Technologies: Providing a Context

This section gives a brief overview of digital technologies in museums with the aim of providing context for the main concern of this paper, which is the current challenges or barriers museum professionals face when implementing digital technologies. The new museum definition reflects the paradigm shift from collection-centric to user-centric that has been taking place in the past decades [20–22]. The new definition was approved by the Extraordinary General Assembly of the International Council of Museums on 24 August 2022, after an open and long process of consultation about the Standing Committee of the Museum Definition with the National Committees, International Committees, Regional Alliances, and Affiliate Organizations. The definition states that:

“A museum is a not-for-profit, permanent 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.” [23]

The new museum definition illustrates how museum work now strives to follow an inclusive and democratic human-centred approach to sustain a range of movable and immovable assets, as well as being open to different voices of interpretation and providing visitors with meaningful experiences through active engagement with the collections [16,22,24]. Digital technologies are used in museums to enhance this new role by making them more accessible, engaging, fun, and attractive, and by creating a unique and memorable experience. This value of technologies in museums is distinctive of our time, in which museums have shifted from “being about something to being about someone” [25]. Technologies entered the world of museums in the second half of the twentieth century, with the first conference on museums and computers taking place in 1968 at the Metropolitan Museum of Art in New York [26]. In this early stage, technologies were used for recording, cataloguing, and researching collections; by the end of the century, their use was expanded to the digitization of museum collections (usually through funded projects) [9]. At the turn of the 21st century, “new technologies” were introduced in exhibitions to increase interaction with visitors [27].

With the advent of Web 2.0 and the ensuing sociocultural transformations, consumers have become active participants in the production of cultural value and meaning through digital infrastructure [28]. Felix Stalder [29] refers to this as the “digital condition,” where referentiality, communality, and underlying algorithms are its characteristic forms. Referentiality denotes how users can “inscribe themselves into cultural processes and constitute themselves as producers” [29] (p. 58); communality is “understood as shared social meaning” [29] (p. 58), where meaning-making processes take place in a larger communal framework; and algorithmicity refers to the facets of cultural processes that are mediated and transformed from “big data” to “small data” by algorithms before reaching human perception (such as Google’s search algorithm). There is a growing discussion in the literature on how museums are responding to this sociotechnical and cultural context brought by the “digital condition” and to the many functions—such as tool, platform, content, and format—of digitality [30–32]. Sejul Malde et al. [33] (pp. 23–24) propose a model consisting of four components or key meanings for defining the active relationship of an individual with the “digital” in the museum context, and these are: (a) how the digital is used either as software or hardware; (b) how the digital is managed as a process entailing vision, strategy, and protocols; (c) how the digital is understood in terms of motivation, behaviour, and impact; and (d) how we create with the digital in our contemporary circumstance. This model is not intended to be rigid but rather to help people think about the “digital condition” in their specific context. Along this line, Jenny Kidd et al. [34] have shown that the “digital” has brought a fundamental shift in how museums engage with their audiences and communities, not only in terms of formats and platforms but also in how the digital is considered a mindset characterised by collaboration, participation, and audience-centricity.

An important idea that conceptualises the active relationship between the digital and museums is that of the “distributed museum” [35–38]. Although the concept has various but complementary approaches, the “distributed museum” could be described as a “space inhabited by people and museum professionals engaging over time across platforms and in multiple locations, negotiating an emergent understanding of cultural heritage” [37] (p. 83). In accordance with Andrew Dewdney et al. [38] (p. 189), the concept of the “distributed museum” brings to the fore “the networked, relational, hybrid and performative dimensions of the museum.” The concept of the “post-digital museum” is another important notion that encapsulates the current circumstance (our post-digital moment) where the digital has acquired a normative function in societies and museums

and is no longer considered disruptive [5]. The post-digital museum has accepted (a) the normative presence of the digital in its operations and performance and (b) the audiences' changing roles. This acceptance has occurred despite the scale or extent to which a museum has adopted digital technologies due to constraints in financial and human resources [32].

Synchronicity and the invisibility of digital technologies are two important elements in the post-digital museum and the societies in which they operate. The contemporary present is characterised by a “coming together of different but equally ‘present’ temporalities or ‘times’, a temporal unity in disjunction” [39] (p. 17), where digital technologies have been infused into material and non-material things and spaces that render them less visible to users [32]. This invisibility is supported by data, a global labour force, and secure servers connected to financial systems, whereas on the front-end, digital technologies operate as naturalised, socialised, and mobile [38]. Alexandra Bounia argues that this signifies an ontological turn where technology has become an inherent part of all aspects of our lives and the societies in which museums operate [32]. For the post-digital museum, this ontological turn means that we have moved from the era of the digital revolution to a change in what museums are and their practices [40]. This is seen in the scholarly and critical reflection on digital technologies in museums (looking at how, why, and where they are used, by whom, and what they enable), which is considered a key characteristic of the post-digital museum.

The diverse use of different types of digital technologies (VR/AR, 3D reconstructions, interactives, audio or multimedia guides, social media, etc.) has been examined in relation to issues such as power, authenticity, and representation [8,27,31,41]. The advantages and disadvantages of using digital technologies in mediating museum collections to visitors have long been a subject of discussion as well; examples include the risk of Disneyfication, which means entertainment is more of a priority than the provision of factual education [42]; whether technological tools can potentially distract visitors or isolate them from their social surroundings during their visit in the museum and limit their interaction with other visitors [43]; and how the “generational divide” materialises into different expectations on the value of technology in museums [44]. However, the perceptions and experiences of museum professionals in adopting digital technologies are understudied, especially the challenges in the digital transformation of museums, which are noted but not explored in depth and, as such, require further exploration [7,45]. The next section reviews the digital turn that occurred during the COVID-19 pandemic to contextualise how it was materialised in museums—which are understood here, in the words of Manuel DeLanda, “as an assemblage of different specialist activities, knowledges, departments, roles, policies and physical sites” cited in [46] (p. 69)—and how it affected their digital transformation.

2.2. The Digital Turn during and after the COVID-19 Pandemic

When the COVID-19 outbreak occurred in March 2020 and the pandemic forced museums around the world to close, an unprecedented and dire situation took place. In accordance with the UNESCO report [47], over 86,000 museums closed in the first wave of the COVID-19 outbreak during spring 2020. This was followed by continuous restrictions that affected the regular operation of museums and rendered their physical collections, at their core, inaccessible to visitors. Museums turned to the digital in order to deal, simultaneously and quickly, with many issues, from the loss of a “qualified and valuable” workforce to the remote “safeguard and management” of buildings and collections to new ways to communicate with solely digital audiences and to respond to political protests (notably the Black Lives Matter movement) [9] (p. 63). The acceleration of the digital transformation in museums during the pandemic has been described as a digital “pivot” [34]. The digital “pivot” concerned strategies and practices because it was a period where museums “as institutions negotiated the sudden centrality of their online presence” and their relevance to their local communities [34] (p. 3).

Museums responded quickly to the dire situation brought by the pandemic by using different digital media and formats (such as websites and social media)—and not

groundbreaking technologies—to deliver their services and reach their audiences [48–54]. Beyond artificial intelligence, machine learning, and big data, digital transformation is connected to social change brought, largely, by social media, whereby the creation and consumption of meaning have become more open and blurred. As noted in the previous section, in museums, this has been translated into a change in the design and delivery of museum work by using audience-centred approaches and narrative (see, for example, the terms user experience, engagement, and co-creation) that became more evident during the pandemic [52,54]. Chiara Zuanni [55] developed a crowd-sourced digital map of museum activities during the pandemic that shows how museums drew on their existing resources (digitised collections) and on the new digital content they created. The new digital content—in the form of virtual tours, online exhibitions and educational activities, podcasts and quizzes, and social media interactions—became the core activities of museums [34,54]. Through the creation of this new digital content, museums also experimented with “hybrid” approaches by blending digital and physical experiences of their collections, events, and tours in the form of downloadable activities, calling for audiences to be creative at home and on behind-the-scenes tours [54]. Areti Galani and Jenny Kidd [56] (p. 300) describe this as “the production of digitally-mediated material encounters” and can be seen as part of the re-evaluation of museums’ relevance to local communities during the pandemic.

It is important to note that many issues arose due to the digital “pivot” of museums, including the question of the monetization of digital assets, communication between professionals during their remote work, the provision of digital access, and the creation of content that would stand out for its quality among so many other digital offerings [34,48]. Museums with prior digital infrastructure and strategy were in a more advantageous position to deal with the effects of the pandemic than less digitally mature museums. This brought to the fore persisting problems in the digital transformation of museums, including the “digital divide” in terms of inequality and access to digital infrastructure among visitors and museums alike, differences in revenue streams and in digital capacity, as well as the need for museums to adapt to the new paradigm of digital-only visitors. As Ross Parry and Vince Djiekan [57] (p.16) argue, this was the moment that showed “how critical the integration of “digital” is to the future of the museum” “. This integration requires fundamental changes in museums in terms of forms, conventions, practices, and communication because “the digital” cannot be considered an add-on tool to museum practices in today’s societies [32].

The first step towards this fundamental change is to have a more granulated and nuanced understanding of digital transformation in the backstage of museums and how museum professionals respond to it. To conduct a multidimensional examination of the challenges, museums are considered in this paper as “peopled organizations” consisting of norms, behaviours, routines, activities, regulations, tensions, materials, aspirations, and values [19] (p. 116). Following Areti Damala et al. [8] (p. 3), this paper uses the terms “digital technology” and “museum technology” as umbrella terms to cover the vast array of digital technologies used in museums today (VR/AR, online ticketing systems, content management systems, digital audio guides, 3D reconstructions, museum websites, digital exhibitions, etc.). To explore the challenges in the digitalisation of museums from the perspective of museum professionals, the next section reviews various types of resources, including project reports and deliverables, qualitative and quantitative surveys, academic articles, edited volumes, and chapters.

3. Results: Exploring Challenges in the “Backstage” of Digital Transformation in Museums

During the pandemic, ICOM and the Network of European Museums Organisations (hereafter NEMO) conducted longitudinal studies to measure the impact of COVID-19 on museums and their digital practices on a European and global scale. These surveys demonstrate that there are discrepancies between museums in terms of human and fi-

nancial resources available for the implementation of digital activities. ICOM conducted three surveys in the period between 2020 and 2021 looking at the impact of COVID-19 in museums. The ICOM 3rd Report [58] analyses data from 840 responses from different sizes of museums across five continents (the survey was open in spring 2021) and shows that 61% of museums had staff working on digital projects but not on a full-time basis; 17.1% declared that they did not have any personnel on digital projects; and 21.9% responded that full-time staff was employed. The NEMO follow-up survey [13] received responses from 600 museums from 48 countries between 30 October and 29 November 2020, with the majority coming from Europe. Over 8 in 10 museums suggested that they require additional support with digital tools and transition. Of those museums, over 40% required assistance with building a digital strategy, followed by the need for new digital infrastructure (23.2%) and staff training (18.7%) [13] (p.5). These surveys show that the “digital turn,” which occurred during the pandemic, is more complicated since museums with already established digital collections, practices, and strategies were quicker to adapt to the new situation than museums that had to rely on outsourcing their digital activities [9]. In the ICOM 3rd Report, it is noted that “the COVID-19 crisis has changed museums’ perception of the digital world forever, highlighting existing issues and accelerating changes that were already in progress” [43] (p. 17). The rest of this section will look into these existing issues by exploring the perceptions of museum professionals through a review of relevant studies.

Ana Carvahlo and Alexandre Matos [59] conducted 12 in-depth interviews and one focus group interview (12 participants) with museum professionals in Portugal in the context of the Museum Sector Alliance (2016–2019), an Erasmus Plus Program (Sector Skills Alliance) whose aim was to support ongoing professional development in museums in Greece, Italy, and Portugal [60]. They also conducted additional interviews with academics and professionals from external companies to further consolidate their results. In their analysis, Carvalho and Matos [59] identified the following challenges: complex maintenance of technological equipment and tools, a lack of a long-term strategy for replacing devices, and the fact that the adoption of digital technologies occurs in an “unstructured and fragmented way” [59] (p. 42). Developing digital applications is considered by this study’s interviewees as an add-on to museum work that has low rates of feasibility due to low budgets, small and multi-tasking teams, and low digital and communication maturity. In the same year, another study was published by Kati Price and Dafydd James [61], who conducted a survey in GLAM organisations with 56 respondents (64% of the responses were from museums), most of them located in the UK and North America, with the remainder being in Australia and Europe, and one in Brazil. These participants highlighted the underinvestment in digital skills, most notably in data analysis and technical leadership.

Paola De Bernandi et al. [62] conducted in-depth interviews with professionals working in 11 museums in Turin, Italy, to examine the role digitalisation plays in museums now and what role it will play in the future. Most of the museum professionals (9 out of 11) at the time of the interviews were still adopting an “unstructured approach” to the use of digital technologies [62] (p. 321), and only 6 out of the 11 museum professionals considered a digital strategy important and were willing to integrate it within the organisation [62] (p. 321). The main challenges identified by participants are systemic financial deficits, institutional pressures, and the lack of coordination between departments. Because the staff has different types of expertise (curation, marketing, and IT), there is difficulty in opening a dialogue between them. Based on their analysis, De Bernandi et al. [62] note old mindsets and cultural paradigms as key challenges in the digitalisation of museums.

Luna Leoni and Mateo Cristofaro [16] conducted a survey that was administered to the directors and curators of 194 Italian small museums. The purpose of this research was to analyse the “extent to which new technologies are adopted by SMs as well as what favours or is an obstacle to their adoption” [16] (p. 5). The most cited challenges are “technology maintenance” (costs associated with the technologies’ preservation) and “financial resources” (availability of internal/self-generated funds) (10% of the responses for each challenge); availability of personnel with technological skills (8% of the responses);

costs associated with technology adoption and/or the existence of hardware and software infrastructures (5% of the responses); and introduction of new technologies created to replace an older version (technological obsolescence) (4% of the responses). This study identified an important paradox: although museums adopted digital technologies based on various trends, these were not received well by visitors, and as such, the digital technologies had to be removed. The participants recognise the beneficial role of technology, but they are also “frightened by the hidden features of the technological element per se” [16] (p. 13). For the researchers in this study, the development of skills through training will provide professionals with the necessary knowledge to address these challenges.

Maria Shehade and Theopisti Stylianou Lambert [7] interviewed 16 museum professionals from 15 different museums in the US, Australia, Italy, the UK, the Netherlands, and Finland on the integration of virtual reality (hereafter VR). The barriers that have been identified relate to the lack of personnel and the necessary funds to hire more personnel and provide training; the need for VR-dedicated teams; and the costs and technical aspects of VR technologies. Specifically, due to the lack of visitors’ familiarity with VR technologies, extra personnel are required at the VR stations, and many museum professionals do not have the expertise for developing, handling, and troubleshooting VR projects. The issue of cost includes the initial equipment required, the extra staffing needs for developing and handling the VR, and the costs of repair and maintenance. This results in VR technologies being used mostly on a temporary basis, usually in exhibitions. At the same time, the authors note that, due to the rapid advancement of VR and other emerging technologies, dedicated departments or labs have started to be formed in some museums.

Paul Marty and Vivian Buchanan [17] present results from an online survey with 34 complete responses, conducted in October 2020, designed to explore the role of museum technology professionals in the US during times of crisis. One specific question they pose is relevant here: what are the most significant factors that contribute to the museum technology sector being negatively affected by financial struggles in times of crisis such as COVID-19? The most common responses were: 21.4% responded that there is a general misunderstanding about the time and effort museum projects need; 15.4% responded that museum technology work is undervalued compared to other museum sectors; and 12% responded that the behind-the-scenes work of museum technology workers is invisible. The study shows that some museums still perceive museum technology professionals a) as not essential to their operation (10.2%) and b) as expensive, which provides little return on investment (7.7%). The authors of the study highlight the importance of developing skills for advocating the value of museum technology, as the role of digital technologies in museums is often not understood.

Finally, in the context of the European-funded project ReInHerit (ID No. 101004545), five focus group interviews took place (online) in March 2022, with 38 heritage professionals participating from 10 European countries (Austria, Croatia, Cyprus, Finland, Greece, Italy, Spain, Sweden, Switzerland, and the Netherlands) [1]. The aim of the focus group interviews, part of a wider primary and secondary research project, was to explore the conditions of adopting and leveraging digital technologies for informing the development of the digital applications that the ReInHerit project would develop (<https://reinherit-hub.eu/> accessed on 4 March 2024). The professionals in these focus group interviews identified some key challenges in the implementation of digital projects, these being the high costs of developing and maintaining digital technologies; the rapid obsolescence of technologies; the ownership of digital objects; the lack of knowledge on the business requirements of using digital technologies; the problems in interoperability of data created from older technologies; and the knowledge gap between museum and ICT professionals, which creates obstacles in their in-between communication. It was noted during the interviews that museums “jump into the digital transformation activities” [1] (p. 37) without considering the life cycle of a digital application and the high costs for developing personalised content, training, supervision, and maintenance. The participants highlighted that digital applications are seen as “one-time solutions” [1] (p. 17) and are abandoned either because

their maintenance is expensive or because they have become obsolete. As a result, the participants commented that new digital applications need to be developed, a process that requires further use of resources for redeveloping and launching new apps from the ground up, thus hindering the process of digital innovation and its sustainability in the sector.

Although this brief review presents insights from museum professionals working in specific temporal and spatial contexts (see Table 1), when viewed together, a more nuanced image of barriers related to the digitalisation of museums is starting to emerge. Drawing from the literature [8,9,16,59,62], these barriers can be categorised into technical aspects (infrastructure, obsolescence, maintenance, cost) and organisational aspects (human and financial resources, vision) of digital activities. The technical aspects include the rapid obsolescence of digital formats; material artefacts, ownership, and data management; interoperability between digital formats and older technologies; and the high costs of developing and maintaining digital technologies and applications with personalised content. The organisational aspects include a lack of long-term vision, different levels of digital literacy between professionals that make communication difficult, and limited budgets available for hiring new staff and for digital projects. The organisational issues of limited budgets, being understaffed, and the need for digital literacy and digital skills are well-known and have been explored in specialised studies [60,63]. It has been argued that organisational culture can be an important inhibitor of digital development [48]. These challenges have been noted in the literature since the early 2000s, when museums considered “new technologies” as expensive and high-risk because of the technical issues of maintenance, costs, and training [15,48,49,64,65]. As also shown by the relevant literature and surveys [9,12–14], the challenges vary for different sizes of museums, as larger museums tend to have more resources to integrate digital applications. This review shows that, although digital technologies are no longer new and have acquired a normative presence in museums, the technical and organisational challenges persist, which makes them systemic problems. This means that the technical minefield, denoting the software and hardware components of digital technologies, is connected to the organisational aspects of human and financial resources, digital literacy, and values. For this reason, obsolescence, maintenance, and abandonment are key issues that will only become more pressing due to the rapid changes in the technical minefield of digital technologies. This raises a crucial question: what will the future of museums be?

Table 1. Comparative overview of challenges in the digital transformation of museums.

Study	Organizational and Technical Challenges
Carvalho and Matos 2018 [59]	<p>There is no long-term strategy for replacing technological devices. The adoption of digital technologies occurs in an “unstructured and fragmented way.” Digital applications are considered an add-on to the museum’s work. Low rates of feasibility due to the low budget, small, and multi-tasking teams. Low digital and communication maturity. Complex maintenance of technological equipment and tools.</p>
Price and James, 2018 [61]	Underinvestment in digital skills (data analysis and technical leadership).
De Bernandi et al., 2018 [62]	<p>Systemic financial deficit and institutional pressures. Lack of coordination between departments as staff have different types of expertise and difficulty communicating with each other. “Unstructured approach” in the use of digital technologies. Old mindsets and cultural paradigms are key challenges in the digitalisation of museums.</p>

Table 1. Cont.

Study	Organizational and Technical Challenges
ICOM 3rd Report, 2021 [58] and NEMO Follow-up Survey, 2021 [13]	Lack of human and financial resources for the implementation of digital activities. Support for museums is required for digitalisation (digital strategy, digitisation, and digital skills).
Shehade and Stylianou Lambert, 2020 [7]	Lack of personnel and the necessary funds to hire more personnel and provide training. Need for VR-dedicated teams. Lack of expertise for developing, handling, and troubleshooting VR projects. Costs and the technical aspects of VR technologies. VR is used for temporary exhibitions since the cost of maintaining VR on a permanent basis is prohibitive.
Leoni and Cristofaro, 2022 [16]	Lack of availability of personnel with technological skills. Costs associated with technology adoption (software and hardware) and maintenance. Introduction of new technologies created to replace an older version (technological obsolescence).
Marty and Buchanan, 2022 [17]	General misunderstanding about the time and effort museum projects need. Museum technology work is undervalued. Behind-the-scenes work of museum technology workers is invisible. Some museums consider museum technology professionals as not essential to the museum operation because it is expensive and provides little return on investment.
ReInHerit H2020, 2022 [1]	Lack of knowledge on the business requirements of using digital technologies. Knowledge gap between museum and ICT professionals, which creates obstacles in their communication. Digital technologies are seen as “one-time solutions” and are abandoned either because their maintenance is expensive or they have become obsolete. High costs of developing and maintaining digital technologies. Rapid obsolescence of technologies. Issue of ownership of the digital objects. Problems with the interoperability of data created by older technologies.

4. Discussion

The purpose of this paper has been to draw attention to the challenges of digital transformation in museums and to reflect on how they are taking place at the “backstage of museums” in the post-digital era in our current circumstances. In the post-digital era, digital technologies are no longer new or disruptive; they have formed different notions of time, space, and being, and they have become inseparable from social action [32]. Museums have accepted the normativity of digital technologies in their operation and performance, whether they have the capacity to adopt digital technologies or not, and to what extent. This review has shown that museum professionals seem to be exerting constant effort to keep up with the rapid changes in digital technologies, with limited resources at hand and the risks of obsolescence and abandonment always present. This creates a continuous cycle of developing new digital applications and technologies as “one-time solutions,” which points to the idea that digital technologies are thought of as supplementary to the traditional museum mission and, based on technocratic and financial criteria, are used to enhance the visitor experience of analogue collections in the specific bounded space of the museum [1,28]. However, digital technologies are not neutral tools in the service of museums; their technical minefield is interconnected with the values, subjects, culture, and concepts of museums. The term “digital” is often used to describe the new sociotechnical relationships—consisting of data, services, content, systems, technologies, and humans—where the internet is a “radical reconfiguration of how ‘the social’ is registered through the operations and functions of communication and

knowledge” [38] (p. 190). The “digital content” can then be seen at the same time as the “digital tool” that provides personalised content necessary to meet the different needs of different audiences [35]. Paraphrasing Parry [5] (p. 37), the acceptance of the normative presence of digital technologies on the one hand, by the majority of museums as shown by Marty and Buchanan’s study [17], and the systemic problems of human and financial deficits, along with the continuous cycle of obsolescence and abandonment on the other hand, signals the moment to reset our relationship with digital technologies in museums. This calls for a nuanced and critical understanding of the values embedded in museum technologies and their impact on societies.

Digital technologies are complex assemblages of data, of hardware, and of software (material and immaterial) depending on global internet traffic, which are ever-changing, creating new dynamics and relationships that require constant reflection and negotiation of traditional concepts such as authenticity, materiality, and power [10,27]. Fiona R. Cameron [66] (p.59) proposes to consider “the digitization more deeply as a new type of ecological composition within multiple, multi-scalar planetary computational structures” connected to consumption and, consequently, to carbon emissions. Digital technologies are distributed, have become “invisible,” and require the infrastructure and cloud servers that operate on the extraction of non-renewable materials, human labour, and data [28,66]. Pasqualina Sacco et al. [67] remind us that digital technologies have a life cycle, starting from the extraction of minerals to the manufacturing stages in factories in different countries and the development of the software, to their use, obsolescence, and the end of their life. In the life cycle of digital technologies, we need to consider the carbon footprint in relation to the increased electricity generation demand as well as issues of cybersecurity and the “digital divide” between those who have access to fast internet, information, and economic resources and those who do not benefit from these [68]. The challenges reviewed in this paper give insights as to how the digital transformation in museums is linked to technological waste, mining of raw minerals to make hardware, labour, and global supply chains through the continuous cycle of technological adoption and abandonment, thus creating new sociotechnical relationships that are in constant flux. In this line, Ed Rodley [37] (pp. 84–85) makes an interesting nod to the concept of “contact zones,” studied and applied to museums by James Clifford in the 1990s, by saying that “when museums are seen as contact zones, their organizing structure as a collection becomes an ongoing historical, political, and moral relationship.” It is important to consider this in relation to the digital transformation of museums and the ethical, political, and historical implications of the continuous cycle of adopting and abandoning technologies, as every local action has potential global effects.

Andrea Witcomb stresses the “constant danger of bringing in the new that it will soon become old” [40] (p. 486) and how it becomes higher in this era of climate crisis where “the future of humanity and the earth has become more precarious” [46] (p. 69). The continuous cycle of adopting and abandoning technologies and the increasing costs of interconnectivity, digital platforms, search engines, and data management systems bear important implications for the sustainability of museums and their (ethical, historical, and political) role in society, as envisaged in the new museum definition. Sustainability as a scholarly, governmental, and business field has grown exponentially since the 1972 UN conference on the environment [67]. There are many approaches to sustainability, but the most widely used is the one derived from the World Commission on Environment and Development and the Brundtland Report in 1987: “sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future” [69]. Sustainability is considered to have the environment, economy, and society as its three pillars, with an increasing awareness of the role of culture in sustainable development [70]. This is the “triple-bottom-line” (3BL) sustainable management theory that sees economy, society, and environment as co-existing in a symbiotic relationship [71]. Sustainability has long been a subject of discussion in museums and cultural heritage [72–78], an example of which is the work on local communities and wellbeing [79]. In 2018, the Working Group

on Sustainability was established in ICOM “to consider how to mainstream the UN Sustainable Development Goals and the Paris Agreement across its range of activities,” which includes supporting museums to accomplish the goals of Agenda 2030 [80]. In accordance with Chris Landorf [72] (p. 495), despite the existence of various approaches to sustainable development, the common principles are the “long-term and holistic planning process, and the active participation of multiple stakeholders,” which involve balancing acts [57]. Giannini and Bowen [20] (p. 199) put forward an important question related to our current post-digital circumstance and sustainability: “museums are now asking, what will be a sustainable model of the future under the impact of the emerging principles of digitality?” This paper shows that it is important to start looking inward at the sustainability of digital practices in museums and consider this as part of long-term and holistic planning.

There is emerging museum literature and guidelines showing how digital technologies can be unpredictable, or how they can enable or hinder sustainable development, with a growing awareness of the ethical implications of digital technologies in terms of human agency, fairness, security, and representation [67,81,82]. The nexus of digital literacy and ethics is a valuable resource for each museum to address the sustainability of their digital practices based on their own contingent circumstances. New museum ethics advocate for museums to “participate in creating a more just and equitable society” [83] (p. 7). For Janet Marstine et al. [84] (p. 70), new museum ethics is a social practice of self-reflexivity and transparency that provides the lens through which to engage constantly with the world and build trust with people. Marstine et al. [84] (p. 91) further argue that “engaging in the new museum ethics is a twenty-first-century skill that museum and museum studies leaders must build among students, professionals, and communities.” Nevertheless, the consideration of ethics and digital technologies in the museum literature has not been extensive, even though museum professionals engage every day with ethical questions in their digital activities, for example, in terms of valuing user contributions, managing risks, and negotiating power [85]. Much work has focused on building the digital literacy and digital capacities of museum professionals to better evaluate “digital” and what it means for museums. Different projects examined digital competencies in museum professionals in relation to challenges and how these can be enhanced to enable the efficient digitalisation of museums [60,63,86]. The One by One: Building Digital Literacies (2017–2020) project advocates for digital literacy that looks beyond “functional IT skills to describe a richer set of digital behaviours, practices and identities” [63] (preface) instead of solely equating digital skills to technical skills that museums can be equipped with to engage in digital projects. As noted by the researchers of the One by One project, this equation will lead to a “skills supply of finite technical competencies that are limited in how flexibly they can be deployed across tasks and roles, which then leads to siloed skill deployment and comparatively narrowly conceived traditional forms of training and development” [63] (p. 34).

The nexus of digital literacy and ethics can act as a valuable resource for each museum to address the impact and sustainability of their digital practices based on their own contingent circumstances. The ethical and social dimensions of human–nature relationships in museums have often been minimised in favour of economic and technical metrics in sustainability discussions [87]. This is evident in the studies reviewed in this paper, as the challenges associated with the implementation of digital activities are considered in terms of technical, financial, and knowledge capacities without further consideration of the impact these practices have on societies. It is here that the post-digital concept becomes all the more relevant as it gives space for reflection and problematization on the “ontological reconfiguration of the role of institutions that are now understood as rhizomatic assemblages of data and things—multi-temporal, multi-spatial, and multi-agent” [32] (p.29). This ontological reconfiguration raises ethical questions for the museum and how it stands as an institution in a sociotechnical and physical world characterised by a radical expansion of connectivity, time, and space. It is necessary for museums to redefine themselves within this complex global context of more-than-human crises and sociotechnical systems where discussions have moved beyond binaries such as “analogue” (considered as traditional,

slow) versus “digital” (considered as having inclusive rhetoric, speed) [40,88]. Of particular relevance to this discussion are the rules formulated by a group of computer scientists in 2010 pertaining to “Moral Responsibility for Computing Artifacts” [89] because they include the sociotechnical systems in which technological artefacts are embedded and their impact as an important part of the ethical framework of technologies.

This comes with urgency in the context of the climate crisis era we live in and the recent calls for transparency and accountability in museums [90]. It entails a multidimensional understanding and knowledge that can help us evaluate why we are using technologies and how to be, in Ross Parry’s words [91] (p. 34), “digitally purposeful.” Adopting and implementing digital technologies will require a deep understanding and justification of their impact on communities, planetary limits, and the environment more broadly. These ethical considerations can provide guidance to clarify thought and action in the post-digital museum. In other words, it is an understanding that, as Zuanni [9] (p. 71) explained, the “possibilities to address challenges in the digital transformation will vary between museums of different sizes, administrative status, and geographical location, so that each museum will need to find a balance satisfying its audience needs, its digital capabilities, and its mission” and to add its impact to what Leoni and Cristofaro have termed the “co-evolutionary organization-environment relationship” [16] (p. 16). Finally, this paper is aligned with this growing literature advocating for a holistic, ethical, and sustainable digital transformation of museums. This means to make a “renewed commitment to ethical—and—just digital heritage practices” [92] (p. 45) by pursuing further research and reflective action on how museum professionals can be empowered to make this the norm in museums.

This is of crucial importance for the future of museums in this context of the rapid transformation and diffusion of digital technologies in societies and the sustainability implications of the “digital.” The relationship between museum ethics, as value judgements situated in specific socio-temporal contexts [93], and digital literacy can become the cornerstone of the digitalisation of museums in that it can allow professionals to engage critically with technologies—to paraphrase Damala et al. [8] (p. 19)—“rather than stare at it” and, instead, see it as a “muse rather than a calamity” in the redefinition of the museums’ role in societies. Sebastian Chan, in his keynote speech at the ICOM Kyoto Congress [26], posited a thought-provoking question on digital transformation: “Who do you partner with to achieve this ethically, sustainably, and in the least extractive manner?” This is a question for museum professionals and academic researchers to deeply explore and reflect on since technologies are in a constant state of being, creating new dynamics and relationships at every moment [27] (p. 10).

5. Conclusions

This paper reviewed a diverse typology of resources to examine the challenges museum professionals face in their digital practices. Addressing the rapid technological, social, and economic transformations—even during health crises—is a constant challenge for museums, whose business model was created almost two hundred years ago. We live in a post-digital era where digital technologies have a normative presence (in different scales) in societies and in a post-COVID-19 period where the “digital pivot” in museums has already occurred. Now, it is important to address the question of the sustainability of the digital pivot that took place in museums during the pandemic. This review has shown that systemic problems exist in the “backstage” of museums across Europe pertaining to organisational and technical aspects of digitalisation, albeit varying in extent. These systemic problems relate to knowledge and skills, consideration of digital technologies as an add-on to museum practices, and deficits in human and financial resources. Operating in this context, museums seem to jump into digital transformation, leading to a continuous cycle of adopting and abandoning technologies without considering the impact of this practice. Two interconnected aspects of sustainability in museum digital practices come to the fore here: one that is inward-looking and one that is outward-looking. The inward-looking aspect is about the sustainability of digital activities and their technical minefield, which

is related to the life cycle of digital technologies and the rapid rate at which we go from adoption to maintenance, obsolescence, and, finally, abandonment of digital technologies. The outward-looking aspect concerns the impact digital technologies have on the social and physical environment of museums on a local and global scale.

Considering how digital technologies are assemblages of hardware and software depending on global internet traffic and infrastructure operating on the extraction of non-renewable materials, human labour, and data, the two aspects of sustainability in museum digital practices raise ethical questions related to power, climate crisis, access, and inequality. This ethical dimension provides the link between the two aspects of sustainability in the digitalisation of museums, as it connects museum values and the position a museum wants to take in the world it stands in with the technical minefield of digital technologies. The dialogic relationship between sustainability and ethics, as shown in this essay, has the potential to contribute to the creation of a “digitally purposeful” museum and, in turn, to a holistic digital transformation of museums in the post-digital era since it can be a framework in which to consider, in conjunction, (a) the sociotechnical context of digital technologies and their impact on humans and nature, (b) the ontological reconfiguration of museums as rhizomatic assemblages of data, things, humans, and non-humans, and (c) museum values and organisational culture. In other words, this relational understanding of ethics and sustainability can be a pivotal first step towards ongoing, deep, and reflective research into different kinds of metrics, skills, resources, the more-than-human, ecology, and the relationship between museum professionals and researchers for forming a digitally purposeful museum in the post-digital era.

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