

Article

Digital Transformation in the Cultural Heritage Sector and Its Impacts on Sustainable Regional Development in Peripheral Regions

Jasmin Sandriester ^{1,*} , Jörn Harfst ¹ , Carmen Kern ¹  and Chiara Zuanni ² 

¹ Department of Geography and Regional Science, University of Graz, Heinrichstraße 36, 8010 Graz, Austria; joern.harfst@uni-graz.at (J.H.); carmen.kern@uni-graz.at (C.K.)

² Department of Digital Humanities, University of Graz, Elisabethstraße 59/III, 8010 Graz, Austria; chiara.zuanni@uni-graz.at

* Correspondence: jasmin.sandriester@uni-graz.at

Abstract

Digital transformation as a strategic goal is not new in the cultural heritage sector, yet it gained momentum due to COVID-19. This is reflected in policies and national strategies across Europe, where digitalisation is often seen as key to sustainable development. This study focuses on small heritage institutions in peripheral settings and explores the opportunities and limitations of digitalisation and its impact on sustainable regional development. A mixed-methods approach was applied, including a literature review, an online survey, focus groups, and a stakeholder interview, complemented by a case study. The findings show an uneven distribution of the perceived benefits, depending on funding, staff, and location. Nevertheless, digital transformation has positive social impacts by enhancing access to, participation in, and awareness of cultural heritage and therefore well-being. However, its economic effects in peripheral regions should not be overestimated. Digitalisation's ecological impact on sustainable regional development is an underrepresented topic in the literature. Moreover, digitalisation is particularly challenging in peripheral regions and for smaller institutions with limited resources and should not be regarded as a guaranteed pathway towards sustainability. This paper contributes to an emerging field by examining the intersection of heritage institutions, digitalisation, and sustainable regional development in peripheral areas.

Keywords: regional development; cultural heritage institutions; cultural heritage; digitalisation; peripheral regions; sustainability



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1. Introduction

The adoption of digital methods and tools in the cultural heritage sector has been discussed since the late 1960s [1,2]. Recently, due to the COVID-19 crisis, this topic has gained further prominence [3]. It is reflected in numerous European policies related to the cultural sector [4], as digital transformation is being considered important in addressing the sector's needs [5]. Yet, a mismatch between the potential benefits of digital solutions and the lack of necessary infrastructures and resources, especially for smaller institutions, often outside urban contexts, has previously been discussed in cultural heritage literature [6–9]. Here, the ability to acquire funding and finance has been stressed as a crucial factor, as “digital transformation all and foremost means innovation and therefore investment” [5] (p. 5). Nevertheless, much less is known about the impacts of digital transformation on the cultural heritage sector in peripheral settings from a sustainable regional development point of view.

While some literature argues that a digital presence may positively influence overall regional development in the long run, enhancing the positive effects of cultural heritage, e.g., by fostering people's place identity [10,11], a broader discussion on regional impacts is missing. This is interlinked with an underestimation of cultural heritage's role in sustainable regional development by (political) stakeholders [12]. Previous studies in this research field have often been project-based, primarily focusing on the economic (e.g., tourism) or social valorisation of cultural heritage (e.g., benefits for the community), missing a holistic perspective. In this context, this article makes an important contribution by highlighting the ongoing digital transformations in the cultural heritage sector and their possible impacts on sustainable development in peripheral regions. The article will pose the following research questions:

1. How is digitalisation embedded in the context of cultural heritage, and how can it contribute to addressing the sector's needs?
2. What are the opportunities and challenges of digitalisation that small heritage institutions face regarding sustainable development?
3. What is the overall impact of digitalisation on the cultural heritage sector in regard to the sustainable development of peripheral regions?

The article will draw on applied research with a qualitative research approach. The analysis utilises research from a European Horizon project on digitalisation and the cultural heritage sector. To assess the regional impacts, it also provides an assessment of an Austrian case study, presenting a snapshot of the practical implications of digital transformations in a peripheral setting and possible impacts on the overall sustainable development of such regions. Thereby, the article is not intended to bring forward a comprehensive overview in regard to digital transformation trends in the cultural heritage sector but rather to discuss possible impacts on sustainable development and raise further research questions.

In accordance with these aims, we introduce the research methods used (Section 2) and present an empirical analysis of the cultural heritage sector's needs and challenges in using digital tools (Section 3). The relationship between cultural heritage, digitalisation, and sustainable regional development is then discussed (Section 4), followed by practical insights gained from analysing the peripheral case of the Styrian Iron Route in Austria (Section 5), a discussion of the results (Section 6), and finally concluding remarks (Section 7).

2. Materials and Methods

A mixed-methods research approach [13] was selected, allowing the integration of different research elements. These partly included research results from the EU Horizon ReInHerit project on sustainable cultural heritage management (grant no. 101004545, <https://www.reinherit.eu/>, accessed on 3 June 2025). As a first step, we conducted desk-based research on the aspects visible in Figure 1, providing a literature background on the topic, mainly used in Section 3 of this article.

In the second step, results from the ReInHerit project were used, which consisted of two research elements: First, two online surveys at the European level aimed at assessing the needs and expectations of digitalisation for professionals in the cultural heritage sector and visitors of museums and heritage sites. The survey was led by the Arcada University of Applied Arts (Finland) and co-developed by the project partnership. The expert survey with 30 questions asked about professionals' current use of digital platforms and their organisations' digital capacity. The visitor's survey comprised 26 questions and collected the general interest in digital tools in a cultural heritage context. The surveys were conducted from October to December 2021 via online distribution. Over 3000 completed questionnaires from 37 European countries were analysed, of which 890 participants were professionals and 2481 were visitors [14]. The second set of ReInHerit research elements were focus group interviews, providing in-depth knowledge about the current challenges

and development potentials of digitalisation among heritage professionals. By following a pre-designed protocol with four main questions as well as sub-questions, an open-ended and semi-structured interview process was pursued. Five focus group interviews were held online in May 2021 with a total of 34 participants [15]. As a follow-up, a second round of focus group interviews took place in March 2022, with a total of 38 representatives in five groups. The focus was on digital innovation as a process as well as an outcome. In this phase, academic, public, and NGO personnel also participated [16].

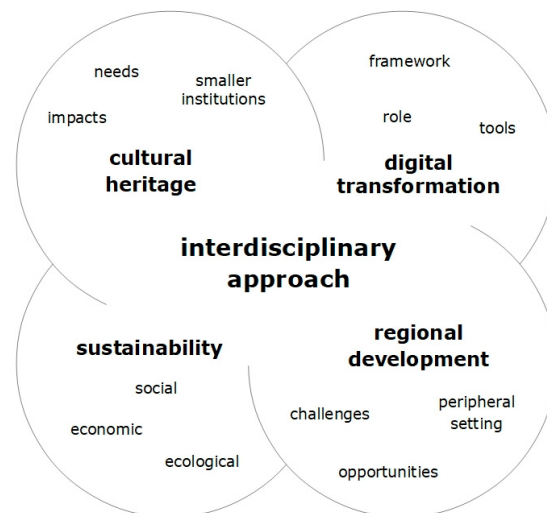


Figure 1. Investigated fields of research.

In the third research step of this article, we have focused on an Austrian case study, offering a snapshot of the practical implications of digitalisation in a peripheral context and its impact on sustainable regional development. Pursuing online research, we screened and assessed the digital offers of cultural heritage institutions and relevant material on digital initiatives in the case study area of Upper Styria (Austria). Additionally, we have also used material from a previous study on 10 museums and their offers [17]. Furthermore, an in-person expert interview with a representative of one of the biggest heritage institutions in the region was conducted in the summer of 2023 using a semi-structured questionnaire. The aim was to gain a local practitioner's perspective from a peripheral region and a comparison to the results yielded in the European focus groups.

The overall research elements for this article are displayed in Figure 2.

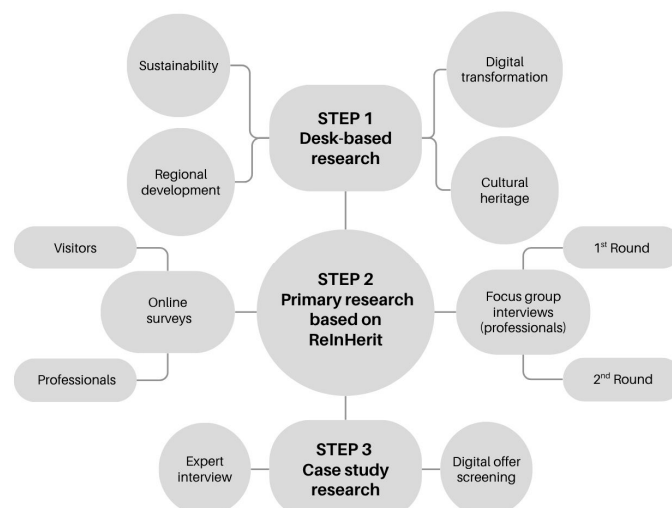


Figure 2. Research steps.

3. Digitalisation and the Cultural Heritage Sector

Digital transformation in the cultural heritage sector is a holistic process that ranges from the digitalisation of collections to digital engagement [18,19]. Research has shown that a museum's digital "maturity" involves the seamless integration of non-digital and digital aspects in outreach practices and management [20]. Thereby, the use of digital tools can range from up-to-date immersive performances (virtual reality and augmented reality) and apps pursuing gamification and artificial intelligence approaches to simple, standard methods such as multimedia stations incorporating audio and video. Online collection portals (e.g., Rijksmuseum) focusing on specific themes, e.g., via digital exhibitions, are also important, and recent experiments using new technologies help visitors' engagement with topics and objects, enhancing their experiences. From a management perspective, digital transformation primarily equates to innovation and investment [5], whereby digital tools need sustainable digital workflows in the long run, with attention given to the latest releases and developments.

Technical trends and innovations have also coincided with a paradigm shift within heritage institutions since the 2000s, contributing to a better understanding of the social and economic benefits of cultural heritage for sustainable development [21,22]. The EU's policy framework includes several strategies, programmes, and initiatives targeting digitalisation and cultural heritage. The flagship initiative is the European Cultural Heritage Data Space, drawing on the success of Europeana, the European aggregator for cultural heritage communities established in 2008 [23], aiming for an alignment of data spaces in the European Digital Decade Strategy [24]. The CH Data Space will be complemented by the European Collaborative Cloud for Cultural Heritage, an infrastructure offering tools and facilitating collaboration in this realm.

In this section, the insights are mainly based on online surveys and focus groups from the second research step. From the conducted focus groups, some recurring themes can be highlighted, which form common needs in the field of digitalisation and cultural heritage.

Figure 3 shows that audience development in cultural heritage institutions was a major topic of concern in the focus groups, and it has been highly researched since the end of the 20th century [25]. Specifically, the focus group participants emphasised targeting specific audiences, such as locals and younger generations. Digital tools, often with gamification elements, are suitable for reaching these targets.

Tightly connected to this issue of relevance is funding: "Funding is crucial, but at the end of the day, I still think that the main issue with funding is relevance" [15] (p. 21). In the focus groups, the creation of new tools and actions was seen as an opportunity to interact digitally with different communities and increase outreach. Digitalisation may facilitate easy access to cultural heritage [6] and provide the opportunity to connect and cooperate in this sector, which is crucial for small institutions to acquire funding [11]. Further, the uneven level of digitalisation and the fact that many digital tools offer one-way communication in regard to audience engagement were critically highlighted. In this context, small institutions suffer from a lack of resources and knowledge gaps, and reskilling is seen as a necessary step for digital transformation [15].

Knowledge shortage was discussed in terms of heritage use for tourism, sustainability, assessment, and evaluation skills, underlining the existing dichotomy in the sector; compared to small institutions, larger ones benefit from experience and resource availability in pursuing advanced technology-based approaches. Interest in digital forms by heritage managers, regardless of museum size, was evident, but the need for technical assistance during implementation was found to be dependent on museum size. The COVID-19 pandemic was an overarching, relevant topic mentioned by the stakeholders, and it was considered both a challenge and an opportunity. Analysing the visitors' responses revealed

that the youth (18–29 years) were more interested in the use of immersive technologies and digital tools than older generations. QR codes were especially preferred over downloading an application. Furthermore, respondents of all age groups agreed that virtual tours and exhibitions were useful.

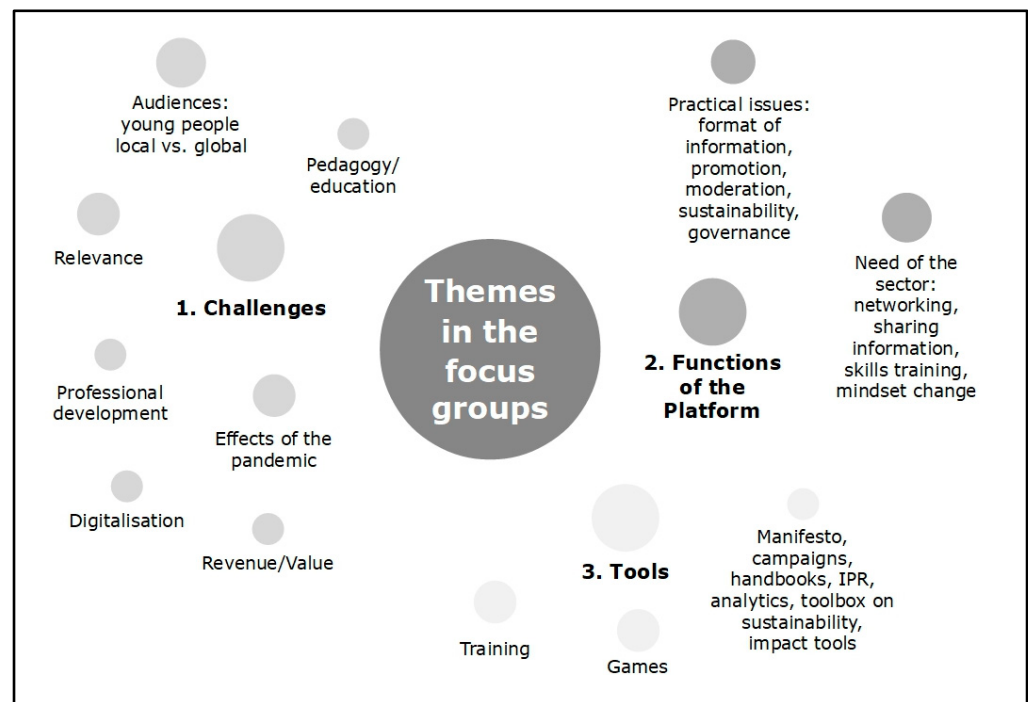


Figure 3. Themes arising from the focus groups in ReInHerit (own representation; adapted from Mazzanti in [15]).

4. Cultural Heritage, Digitalisation, and Sustainable Regional Development in Peripheral Regions

Since the mid-2000s, digitalisation has featured prominently in discussions around the sustainability of cultural heritage [8]. This connection is fostered by European strategies, as cultural heritage is said to contribute to more resilient and innovative societies and social cohesion [26]. Therefore, the literature widely acknowledges its importance for local and regional development [27,28]. Here, cultural institutions play various roles in regional development, operating in multiple—social, economic, and ecological—spheres of action [11,29] and on several vertical governance levels in rural areas (i.e., council-run, voluntary, historical societies) [30].

The Austrian Council for Sustainable Development 2022 considers “digitalisation as an optimal tool for sustainability and transformation in the field of sustainable social, economic development and climate protection” [31]. However, critical voices have pointed out that sustainability is not given per se but is rather enabled in a set frame [32,33]. Further, the term “sustainability” has been widely (mis-)used in recent times and is now associated with policy goals [34]. The most well-known model is based on the Brundtland report [35] and emphasises the ecological, economic, and social pillars. Although various definitions have emerged since then, the simplest, most common version [36], namely the three-pillar model, was used in this study.

4.1. Social Pillar

The social impacts of cultural heritage have been widely addressed in previous academic discussions. Specifically, life satisfaction has been shown to be positively influenced

by heritage visits, volunteering, and digital engagement [37]. Further, a positive impact on one's quality of life was observed [38]. Effects also show that overall well-being, as a multisided social construct, benefits not only individuals but also society at large [26]. This is especially relevant for heritage experiences, fostering psychological stability, self-esteem, perceived safety, sociability, and place attachment [10]. Furthermore, by providing spaces for encounters and community hubs, common activities for volunteers, as well as constituting a source of identity and pride, cultural heritage contributes to the creation of social capital [38].

At the regional level, especially in peripheral rural areas [30], cultural activities and localised cultural identities play essential roles in resilience building [29]. Cultural institutions thus help not only in developing but also in promoting social capital [11] and place-based identities [29,39], fostering place attachment in the long run [10]. Thereby, a perceived high quality of life, which can be fostered through positive experiences and personal networks via cultural heritage offers, can contribute significantly to one's identification with a region [40]. This has positive effects on people's attitudes, behaviours, satisfaction [41], civic pride, and sense of place [42]. From the perspective of sustainable regional development, soft factors such as social cohesion and place attachment especially matter in the context of (youth) outmigration—a challenge that peripheral regions often face [43].

Digitalisation can facilitate easy access to cultural institutions both within and outside rural or peripheral communities [6]. This is especially relevant for marginalised groups (e.g., people with disabilities, low income), as more inclusive spaces are emerging [8]. However, the implementation of digital strategies, e.g., for exhibitions, may potentially exclude older generations, who may need additional support. Nevertheless, digitalisation can provide communities with new ways to share their heritage objects and let their voices be heard, without materially donating the objects and losing ownership [44], thus serving as an incentivised, cost-effective solution for cultural development in peripheral regions.

By providing access to the cultural heritage sector, digitalisation can have a strong social impact on local communities, positively impacting both personal and societal well-being and a region's overall resilience. It further enables worldwide outreach, promotes relationships between museums and their communities, and fosters participation in creating digital heritage and upgrading museum visits [7].

4.2. Economic Pillar

One possibility for peripheral regions to build their tourism profiles is to focus on cultural heritage [45]. Digitalisation can enhance the overall touristic experience in these regions [46], and cutting-edge technologies such as AR can even boost their competitiveness [47]. However, many local community museums are run on a voluntary basis and lack digital literacy skills and resources [9]. Statistical data have revealed that half of the cultural institutions participating in an American survey across the states ($n = 480$), especially small ones, have no or only one dedicated digital staff member [48]. Furthermore, the maintenance costs of servers, digital systems, and archives have to be considered, requiring additional technical expertise [30]. In remote regions, limitations are also evident in the resources and power, as well as in community engagement, required for digital technologies [9]. In Austria, only 5% of the overall museum budget is allocated for digital actions [5], and digital investment is the first section to be limited when having to cut costs due to financial restraints [49].

In general, to guarantee sufficient organisational or financial support [11], local governments need to consider cultural heritage as an attractive force [50]. In best-case scenarios, multiplier effects are seen in jobs, services, and products, creating income and strengthening creativity [51]. However, peripheral regions face challenges beyond deficits in government-

tal support and infrastructure, such as the lack of proper destination management [52]. Another decisive factor in peripheral settings is access and therefore distance to the core. Digitalisation can help overcome obstacles to access and may serve as an incentive to stimulate in-person visits [7]. However, to make visitors travel longer distances, the cultural attraction has to be relevant [53]. This is a major challenge that museums face today, and digitalisation may have an indirect positive impact on the same by raising awareness. Therefore, while cultural heritage tourism is seen as a valuable activity for fostering sustainable regional development processes [54], its economic value must not be overestimated in peripheral settings, as tourism is often operated as a secondary income source.

4.3. Ecological Pillar

Museums' educational role in climate change discourses has been stressed manifold [55,56]. Yet, in regard to cultural heritage and sustainable regional development, the ecological sphere has played a comparatively minor role in academic and strategic discussions [39,57]. This is supported by the focus groups [15], where sustainability was a major topic, but ecological concerns or opportunities were rarely highlighted. In a critical self-reflection, this aspect was also not part of the focus groups' direct questions. Hereby, digitalisation is primarily considered under the notion of clean energy use and the ecological footprint rather than in the frame of regional development. Specifically, digitalisation is assumed to increase energy and material consumption instead of meeting sustainable ecological goals [32]. Nevertheless, cultural institutions can act as role models by promoting clean energy use and ecological designs as well as by creating new forms of mobilisation and participation through digitalisation [42]. Digitalisation may further help in the context of climate change, for example, by establishing a centralised information system for knowledge exchange and cross-sectoral coordination for the inclusion of cultural heritage in climate-change-relevant policies and actions [58]. In this context, digital restoration and documentation also contribute to long-term preservation [59], which can be supported by sensor-based environmental monitoring strategies to mitigate climate-related deterioration, illustrated by recent applications [60].

Furthermore, digitalisation facilitates a different engagement with and experience for the audiences, which is needed to illustrate the embeddedness in a larger, non-abstract context, enabling the narrative's co-creation in climate change discourses [55]. Additionally, digital preservation constitutes a major topic in this context and one of the European Commission's priorities, reflected in the available funds of the Digital Europe programme [61]. Initiatives such as the Museum for Future Movement and the German Museum Association's climate protection guide [62] underline this emerging topic in the digitalisation discourse. Furthermore, the Digital Economy Report [63] also underlines digitalisation's role in fostering environmental sustainability through cross-sectoral coordination and data-driven optimisation. Yet, according to the report, benefits depend on the mitigation of rebound effects, as increased digital demand can offset the ecological gains.

In peripheral regions, ecological issues may arise at hotspots where overtourism is evident, and the management and infrastructure at these places face capacity breaches, e.g., due to increased arrivals post COVID-19 [64]. Additionally, digital tools can help to channel and control tourism flows, e.g., via ticket platforms.

5. The Styrian Iron Route—A Case Study

In a third research step, to practically test and underline some of the theoretical reflections presented in the previous sections, some of the issues were analysed by using an Austrian case study. The "Styrian Iron Route" is located in an old industrial region of Styria and has a long tradition in mining. In the 19th century, it became one of Austria's industrial

centres [65]. However, since the 1960s, the region has lost importance as globalisation and the accompanying market developments caused regional iron production to decline [66].

The region's rich mining past forms the core of its cultural heritage. To preserve and highlight it, a regional working group was formed, from which the "Museum Association Styrian Iron Route" was established in 1986. This association, including 12 regional museums, conducts joint marketing and management activities. Hereby, the active mining site of the Styrian Erzberg is of particular relevance, as it runs an additional tourism tour programme. Many smaller cultural monuments and industrial-heritage-related facilities are run on a voluntary basis and therefore preserved through the engagement of local people. This sometimes leads to limited visitor capacities and opening hours. In addition, the city of Leoben has a modern museum centre. The intangible heritage of the region also includes mining customs and traditions, an immaterial UNESCO World Heritage. However, national comparisons have shown that the Styrian Iron Route has a low tourism profile on the market due to limited capacities and relevant structures [39].

After screening digital heritage offers in the region, we determined that the museum association and the individual institutions have web appearances on home pages or social media channels, albeit with few interactive elements and irregular content updates, leading to static content. Nevertheless, various projects related to digitalisation and cultural heritage have been initiated in regional institutions, as the stakeholder interview revealed [67]. Front-end digital tools such as media stations, 3D tools, and virtual museum tours are offered in the bigger museums, but their success and use value are, in contrast to the focus groups, seen as critical in the case study region, as such techniques "are fast moving [...] and it is a question of money" to use them [67]. Technical maintenance poses a challenge, as it is time-consuming and requires appropriate human resources and budgets, both of which are limited. This point did not play a major role in the focus group interviews, where its implementation was rather considered as the challenging part. So, while VR glasses and auditory aids are used in current museum activities, QR codes are only provided for certain periods during exhibitions and are not widely used anymore. Although the introduction of digitalisation projects is funded at the regional, national, or EU level, follow-up costs are not considered or supported, which makes it difficult to sustain individual implementations. The interviewed expert stated that their institution decided "to consciously move away from digital tools", as the efforts to maintain such applications are beyond the museum's capabilities [67].

Instead, "priority is given to the digital acquisition of objects" [67]. However, employees in small, volunteer-run museums do not have the necessary know-how or resources for digitalisation. The museum association has therefore employed an individual for two years as part of a funded project to digitise the catalogues of its institutions and to promote the digital inventory of objects. The aim is to incorporate the material into a separate database across the province and, as a (long-term) goal, to link it to the European platform Europeana. In contrast to the outcome of the focus group interviews, the true added value of digitalisation is thus seen in back-end activities, the digital inventory of objects, rather than front-end, user-related activities. Otherwise, the museum's focus is on museum pedagogy via workshops and the expansion of experience stations for visitor use. This corresponds with the expert's view that "since everything in life is already digital, people are happy to do something different in the museum" [67] and that a museum can be "seen as a refuge from the digital world" [67].

Regarding regional development, the expert underlined cultural heritage's crucial role. The museums have educational and cultural missions but are especially challenged in promoting local identity. Rather than putting the youth at the centre of attention, children in particular are considered "multipliers for visits" [67], as they tend to visit cultural sites for

the first time through their schools and return with their families. Further, these institutions have the potential to promote ecological tourism in the region and continue creating incidental sources of income, but they need an anchor at the local level. For this, and to initiate crossovers of events and exhibitions, the networking of institutions, especially for small associations in peripheral areas, is important. Therefore, personal networks in the arts and cultural sectors of peripheral regions are perceived by the interviewee as more relevant than digital asset development.

6. Discussion

Digitalisation in the cultural heritage sector, in terms of digital transformation, is considered a holistic process, often connected to innovation [5,18,19]. It includes a range of front-end and back-end applications, with digital tools both contributing to the museum's mission in preserving cultural heritage and targeting the improvement of visitors' overall experiences. Regarding the first research question on how digitalisation is embedded in the cultural heritage sector and how it can contribute to the sector's needs, the literature review revealed that digitalisation is considered relevant for promoting sustainability and resilience and is included in European and national strategies, especially against the background of the COVID-19 pandemic [68]. Furthermore, the European expert surveys and focus groups revealed positive attitudes towards the use of digital tools. Many experts perceived digitalisation as the right way to address the sector's challenges, such as its relevance in a changing media environment or outreach to specific target groups (e.g., youth). Digital front-end applications were seen as tools to attract new visitors, and back-end applications were seen as fostering exchange. Further, funding was mentioned as contributing to uneven digitalisation, highlighting a lack of skills and training, especially in smaller heritage institutions.

On the other hand, in the case study area, digitalisation's advantages were primarily associated with the "back-end", in terms of object categorisation, data standardisation, and exchange, as well as participation and dissemination via (inter-)national platforms. In the surveys, the experts emphasised that digitalisation could increase the attractiveness and relevance of cultural heritage institutions. In our case study, this link was somewhat denied, as front-end digitalisation was seen as costly, draining financial resources, which are rather invested in non-digital offers, such as on-site pedagogy classes. In general, our case study yielded different results and perspectives compared to the expert surveys and focus groups.

The second research question dealt with the opportunities and challenges of digitalisation that small heritage institutions face in regard to sustainable development. The findings, based on the results of the previous sections, are compiled in Table 1.

In relation to the first pillar of sustainability, the social dimension, opportunities were identified, as digitalisation plays a significant role in enabling institutions to engage with stakeholders and seek collaborations. This first step is vital in gaining access to innovation processes [46] and is especially relevant for smaller peripheral institutions, as networking can be considered key for future success [67]. Regarding the sector's needs, the focus groups were confident that digitalisation could reach the youth and locals, allowing institutions to gain more relevance. In contrast, in the case study region, no such gains were perceived due to digitalisation efforts; rather, the mediating role of cultural institutions was seen as the true asset. The positive effects of digitalisation were mainly attributed to an increase in people's awareness of events at short notice. The institution considered itself primarily valuable to the locals and their communities. When materials and immaterial knowledge/skills were passed on to younger generations, the case study relied on hands-on workshops, intentionally outside the digital sphere. Children were found to act as "multipliers" of

museum visits, strengthening visitors' place identity and sense of belonging in the long run; therefore, museum offers were aligned accordingly [67]. This highlights that cultural institutions in peripheral settings mainly serve and target local communities, and their highest impact therefore is considered on the social level.

Table 1. Needs, challenges, and opportunities in sustainable regional development for digital transformation and cultural heritage.

Digital Transformation and Cultural Heritage in Regional Development			
	Needs	Challenges	Opportunities
Social	- Increased relevance - Engagement with and motivation of locals	- Limited perceived impact - Exclusion of the elderly - Preference for real before digital experiences in pedagogy/education	- Fostering place attachment and well-being in the long run - Easy access to heritage content - Social cohesion and resilience building
Economic	- Resources (human and financial) - Support of local governments - Proper destination management	- Lack of funding for tool maintenance - Shortage of human resources/know-how in small institutions - Digital investment based on other budget cuts	- Regional competitiveness boost - Additional revenue (e-shop, etc.) - Incentive to visit (multiplier effects)
Ecological	- Sustainable on-site museum management - Increased awareness about ecological impacts of digital (museum) offers	- Lack of green and sustainable museum practices - Increased energy consumption	- Ecological education and role model function - Conservation of heritage (e.g., climate change) - Raising awareness

Regarding the economic pillar of sustainability and cultural heritage's valorisation of tourism, institutions have to be considered relevant and valuable by regional stakeholders [11]. When seen merely as "nice to have", as in the case study, investments flow into infrastructure first [67]. In the case study, most visitors were locals, except for a few day trippers [67], whereas international audiences and proper destination management for economic value were lacking [52]. The intense maintenance efforts required to keep digital technologies up to date are not covered in European projects [67]; an issue not yet appropriately addressed in the literature. The preliminary work required for "back-end" processes of data compatibility and joint working interfaces was also found to be neglected according to our interviewees, although it should be noted that a significant part of cultural heritage funding for digitalisation, both at European and Austrian level, is in this direction, with programmes such as "Kulturerbe Digital" supporting numerous projects, especially with a focus on smaller institutions, in recent years [69]. Therefore, it is necessary to ask whether digitalisation investments may be based on other budget cuts. Given these circumstances, our case study institution "has decided to consciously move away from digital tools" [67]. However, financial opportunities may arise from new sources of revenue (e.g., e-shops, on-demand offers) as digital transformation occurs.

The third axis of sustainability, the ecological dimension, has rarely been addressed in the literature in relation to cultural heritage and its digital transformation. With the focus on clean energy use and server cooling, the downsides are rather obvious. In theory, institutions may act as role models through educational efforts, ecological infrastructure, and mobility concepts. However, these involve additional costs. The interview in the case study region showed rather a lack of focus on the environmental impacts of the museum offerings. Yet, awareness of these issues could be raised through climate protection

guides and the green museum movement, so that an appropriate, ecologically sustainable management of individual institutions can be introduced. Whether cultural heritage *per se* fosters a form of ecological tourism and projects remains an open question.

7. Conclusions

While discussions around digital transformation in the cultural heritage sector are far from new, the COVID-19 pandemic has triggered further academic and political attention, esp. as a means for sustainability and resilience [68]. The impacts of museums on regional development have been discussed in the literature, but a knowledge gap remains about the triad of digital transformation, cultural heritage, and sustainable regional development. Therefore, for this article, existing theoretical and empirical findings were reviewed and compared with a case study in a peripheral setting.

As a result, an uneven distribution in the perceived opportunities of digitalisation was revealed; smaller institutions, dominant in peripheral regions, face additional challenges due to location factors and financing issues, influencing their overall attitude toward digitalisation. In general, digitalisation is perceived as an important tool for addressing the cultural heritage sector's needs and challenges. However, these needs vary across different types of institutions, leading to different views on digitalisation's opportunities and prospects. This calls for further case-specific reflections, as digitalisation is seen in the literature and by many experts as impacting overtly positively on the sector's needs.

In regard to sustainable regional development, the most significant positive impact of digitalisation in the cultural heritage sector is in the social sphere. This is supported by Murzyn-Kupisz and Działek's (2013) claim that the social dimension is especially strengthened when people participate, experience, or are aware of cultural heritage institutions and their activities [38], positively affecting a range of social factors [10,26,41]. Digitalisation thus functions as an important tool for reaching out to local communities. However, in practice, our research has revealed that it is questionable if digital tools are suitable for supporting transfers of knowledge and hands-on skills to younger generations, as they might divert necessary funding from other heritage-related activities. Furthermore, an inclusive approach must be adopted and the associated challenges addressed to ensure that older generations are not disadvantaged.

The economic impact of cultural heritage tourism, particularly to initiate sustainable development in peripheral areas [54], is low. For digitalisation to make an impact, an increase in in-person visits is required; with the hindering location factors that peripheral regions face, relevance is key to motivating visitors to travel greater distances [7]. Innovative digital tools can act as unique selling propositions, but the related costs, especially for maintenance, may make this unlikely in the given context. Further, smaller museums often focus on the local community and lack outreach to international audiences and, therefore, economic value added. Rather, smaller peripheral museums have to facilitate cooperation to survive and fulfil centrally delegated digitalisation demands [6]. There is also a need to develop new tailor-made offers for small institutions to valorise their assets within their capabilities and profit financially from digital tools. Accordingly, much more practical research is needed to identify suitable digital approaches that have economic value for smaller heritage institutions. Ecologically, studies have focused on digitalisation's downsides (esp. energy consumption), but its impact on regional development has rarely been addressed and requires much deeper research, as this axis is rather ignored by most studies in the field.

Overall, the analysis provided here shows that digital transformation in the cultural heritage sector does not create a win-win situation in terms of sustainability for regional development *per se*, as the arising social, economic, and environmental challenges (see

Table 1) must be addressed properly. Therefore, it supports the call for a set frame [32,33,70] to enable it. Geography especially matters (also) in this context. Digitalisation is particularly challenging for peripheral regions and small institutions with limited resources, where community participation is often chosen over digital involvement, which further limits the possibilities of cultural heritage preservation [9]. In this sense, “museums need to be areas for cultural transmission where the responsibility is given back to the community to protect and care for their cultural and natural heritage” (p. 128) [7], with “good and direct personal agents” [67] as success factors. More research, especially through case studies, is needed to understand the roles of small heritage institutions and the digitalisation opportunities they can seize, considering their place-based potential. Therefore, research must provide more realistic assessments of what kind of potential digital transformation holds for different regions and institutions and through which digital tools this can be achieved.

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