

# Artificial intelligence in the context of cultural heritage and museums

## Complex challenges and new opportunities

### SUMMARY

As digital technologies have been increasingly permeating our lives, artificial intelligence (AI) has gradually made it onto the scene too, but without much fanfare. This once daunting prospect has become a part of our lives even in domains that do not seem to belong to a futurist world, such as cultural heritage and museums. The results are both promising and surprising: reconstructing a piece of art, completing an unfinished composition of a great musician, identifying the author of an ancient text, or providing architectural details for a potential reconstruction of the Notre-Dame de Paris cathedral would have seemed like science fiction just a few years ago.

Applying AI in the public cultural domain requires investment in many areas, the most obvious being infrastructure, equipment and highly qualified human resources. Human resources are essential, as AI needs to be fed with high-quality data to be trained to perform its tasks. Data needs to be interoperable and properly described with metadata. Moreover, copyright issues must be resolved before such data is used, and cultural heritage professionals need to learn how to navigate this complex terrain skilfully.

The EU has a rich cultural heritage, and its numerous top museums and works of art are a precious resource for its cultural and creative industry. Yet, it depends on the United States for its online cultural platforms and on Asia for its equipment. Presently, it is making efforts to change all this and to preserve its cultural and creative resources in digital form in order to amass the data needed to put AI at the service of its cultural heritage and museums. AI can also be beneficial for archaeological and historic research, helping deepen knowledge and localise sites. To foster these developments, the EU has issued recommendations setting targets for the 3D digitisation of the Member States' cultural heritage sites and monuments, but also for relevant capacity building and training.



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## Introduction

Artificial intelligence and robots have inspired both artists and engineers throughout the ages. Artists' visions of human-machine relations vary drastically, contrasting '[happy humans with AI-slaves](#) against visions of defeated humans ruled by machines'. The latter view is predominant across Europe, where [43 % of Europeans](#) think AI will be harmful and 38 % believe it will be helpful.

Experts point out that the [negative narrative](#) can be reduced to two categories: *existentially spectacular* AI, which takes over and surpasses human intelligence, or *individually threatening* AI, portrayed as a risk to our livelihoods and safety. However, between these extreme narratives, there are many possibilities, which include ones allowing for a beneficial and equitable future.

In fact, such a future has already burgeoned. Despite divergent views on its uses and no common agreement upon its [definition](#), AI is already widely used in many sectors. The cultural heritage and the museum sectors are no exception.

### IBM's The Voice of Art project at Pinacoteca de São Paulo

According to the Brazilian Institute of Economic Research, the [majority of Brazilians](#) (72%) have never been to a museum because they believe that art is difficult to understand. Yet, it is the lack of education that makes interpreting or understanding art difficult. IBM, which was preparing to launch Watson, an ultra-high-performance AI computer in Brazil, decided to address this situation by harnessing Watson's talent. In collaboration with the Pinacoteca de São Paulo Museum, IBM created The Voice of Art, an AI-powered assistant device serving as an interactive exhibit guide where Watson answers museum visitors' questions.

[The Voice of Art](#) uses [natural language processing \(NLP\)](#), [cognitive computing](#) and [machine learning \(ML\)](#) to allow visitors to interact with specific paintings and sculptures in the museum, thereby enabling a personalised visiting experience. At the entrance to the museum, visitors are handed a headset and a smartphone device with The Voice of Art installed on it. As they walk around the museum, they receive a notification from the device inviting them to ask questions about nearby works of art on the headset microphone.

Unlike other traditional museum guides using recorded scripts, The Voice of Art answers visitors' questions in real time using [cognitive chatbots](#) that understand human language and intent through its IBM AI service.

To develop Watson's function to answer questions, IBM programmers received information and answers about art collections by interacting with the museum's curators and researchers for 6 months. The data they collected comes from research and data mining, books, old newspapers, academic biographies, interviews and internet search. Consequently, the answers The Voice of Art is capable of giving to the audience range from historical and technical facts, such as painting techniques, to the relationship between the collection and the contemporary world. In situations where The Voice of Art is unable to give a proper answer, it has the capacity to learn through machine learning technology and answer correctly the next time around.

Through The Voice of Art, the museum provided visitors with empirical storytelling to revitalise their appreciation and to teach them more about the historical contexts of collections. Since the start of its use, the Pinacoteca de Sao Paulo Museum has seen a jump in visitor numbers by 200 %, which can be explained by the enhanced accessibility of the art itself and the elevated experience offered to visitors with the help of AI using [reinforcement learning](#).

Source: F. Barth (2017, June 3). [Some Technical Details and Challenges](#) of project: 'The Voice of Art – IBM | Watson'.

Fear of AI is rooted in the complexity of its [technology](#) but also in the understanding, until quite recently, that intelligence is the exclusive attribute of human beings, or at least of animals (intelligence, neural, learning etc.). AI is based on algorithms and computer programmes using machine-learning techniques for searching and analysing data. The way such technologies and algorithms function and AI systems use our data often has a black-box effect, i.e. a situation where AI systems are capable of producing results, but the process by which the results are produced and the reasons why the algorithm makes specific decisions are not fully understandable by humans.

## What AI can do for cultural heritage and archives

In some spectacular cases, AI technologies have made it to the front pages of the world press. Rembrandt's famous painting, [The Night Watch](#), at one point of its history had its bottom and left sides cut off. Thanks to AI technologies, the missing parts were reconstructed and the restored painting is once again on display in the [Rijksmuseum](#) in Amsterdam. Another notable example is the completion, with the help of AI, of Beethoven's unfinished [Tenth Symphony](#). It is worth remembering that AI needs an expert input by researchers to succeed, as it is an important tool, but the human factor is essential.

EU funding contributed to another success – the identification of Lope de Vega as the author of '[La Francesa Laura](#)', a theatre play whose author was unknown. [European researchers](#) used [Transkribus](#), an AI-powered platform for text recognition, transcription and searching of historical documents. This useful tool was developed with Horizon 2020 funding, and it can be applied to documents from any place, any time, and in any language.

AI can be crucial for the detection of hidden archaeological sites. Forests surrounding [Utrechtse Heuvelrug](#) and the [Veluwe](#) areas helped preserve archaeological artefacts from destruction caused by human activities, but also made them difficult to discover. Thanks to the [LiDAR](#) (Light Detection and Ranging) method, which enables research in locations where archaeological remains are concealed by forest or other vegetation, high-resolution elevation maps could be made. The process generates a large amount of complex and high-quality data, which entails complex processes and knowledge to process it for archaeological object detection using AI. In 2019, Leiden University's Leiden Centre of Data Science ([LCDS](#)) and the [Data Science Research Programme \(DSRP\)](#) at the Faculty of Archaeology developed a flexible, robust and automatic detection method for archaeological objects, which uses both LiDAR data and R-CNN (region-based convolutional neural network – a technique used in deep learning, one of the sub-sets of AI) to automatically recognise specific historical sites in the region and thus to facilitate and accelerate the process.

The entire surface of the Netherlands has been measured by airborne LiDAR, providing a detailed elevation model, which has made it possible to investigate areas of data obscured by forests. Deep learning works better with more data to train and learn, but as regards object detection in archaeology, the available dataset is comparatively small. Commonly used algorithms for object detection, referred to as [convolutional neural networks \(CNN\)](#), learn and classify images while maintaining spatial information of data (images). The technique addresses the problem of the limited size of the dataset, by allowing the use of pre-trained data from large amounts of data in the learning process. These are then re-usable and can be optimised for small datasets. However, in archaeological object detection, it is also very important to obtain the exact [localisation](#) of archaeological objects in a wide landscape. Researchers tried to overcome these limitations by using [R-NN \(Fast R-CNN\)](#) deep learning techniques that correctly localise, classify and detect objects within large images. They succeeded in detecting two objects (barrows or ancient burial mounds, and Celtic fields) in the research area, but were unable to detect the existing [charcoal kilns](#), as there was no data for training the system. The team expected to improve further the results by increasing the number of training data sets.

To this end, human involvement was essential. In the case of the Utrechtse Heuvelrug, the [Heritage Quest](#) project started to search for archaeological heritage in April 2020. Over 6 500 volunteers actively participated in this [citizen science project](#), funded from the Horizon Europe programme, localising burial sites, charcoal kilns and various artefacts. Most importantly, the results showed that these areas were under quite intensive crop cultivation 3000-2000 years ago, changing understanding of local history. This was the first ever involvement of citizens in a large-scale archaeological scientific project. It combined human effort with AI applied to cultural heritage and resulted in the project receiving the [Cultural Heritage Award](#) in the [research category](#) at the Cultural Heritage Summit 2022 in Prague.

## International organisations' views of AI

Digital technologies and AI in particular have economic and societal benefits capable of contributing to various activities – public or private – in the domain of health, the environment, agriculture, banking, culture and many others. They do not necessarily trigger negative narratives inspired by dramatic artistic visions, but as their deployment is also a commercial activity that needs investment and resources and brings revenues, a realistic approach to their assessment is necessary to allow policymakers to decide on them and if necessary take action to avoid abuses and risks.

International organisations have been reflecting on AI and its various aspects. For instance, the [OECD](#) devoted a virtual pavilion of the COP27 to AI's [environmental footprint](#) and sustainability, as it uses natural resources such as electricity and water. The [OECD AI Policy Observatory](#) was set up to follow the developments of the technology across different domains on the European continent.

Already in 2019, the [Council of Europe](#) focused on [human rights](#), democracy and the rule of law aspects of AI and the [manipulative capabilities](#) of algorithmic processes. In an effort to help regulate AI, it provided [policy recommendations](#), declarations and guidelines. In January 2023, the Council of Europe's Committee on Artificial Intelligence ([CAI](#)) decided to make public the 'zero' draft convention, the basis for the [\[Framework\] Convention](#) on artificial intelligence, human rights, democracy and the rule of law.

[UNESCO](#) has worked on AI-related ethical and inclusiveness issues, and its efforts led to the adoption, in November 2021, of the [Recommendation on the ethics of artificial intelligence](#) as the first global standard-setting instrument. It aims to promote human rights and human dignity.

## European Union in the AI race

The EU as well has been involved in reflection on AI, its benefits, risks, resources needed and possible legal implications. A 2020 [study](#) by the European Parliamentary Research Service analysed various issues to be considered at different decision-making levels regarding the development and placement of AI on the market. It also highlighted the need to include citizens in the process, as 'employment impacts and privacy intrusions are increasingly tangible for citizens while the promised benefits to their health, wealth and environment remain intangible. The response could include targeting more ambitious outcomes while making more modest promises'.

Having joined the AI race, the EU aims to foster a competitive market for the EU's small and medium-sized enterprises (SMEs), and ensure that AI complies with EU values and law while also addressing citizens' expectations and fears. Since the majority of companies in the cultural and creative sectors (CCSs) across the EU are [SMEs](#), and since [intellectual property](#) and copyright are the backbone of the cultural and creative sectors' activity, finding answers to the above issues is of particular importance for them. At the EU level, many Parliamentary committees and Commission directorates have been involved in AI-related policy, which only goes to show how wide the scope of action and how diverse the concerns linked to AI can be. However, there is no single body in charge of AI.

There is an ongoing debate on an AI definition at the EU level. The Parliament wants it to be based on the [OECD](#) concept. This unresolved issue is a [major obstacle](#) in the current discussions on the adoption of an EU act on AI.

## European Commission

The complexity of the AI policy is reflected in the fact that it is on the agendas of a number of Commission directorates general (DGs), agencies and other bodies. These include the Directorates General for Communications Networks, Content and Technology (DG CONNECT), Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) and Justice and Consumers (DG JUST), the EU agencies for cybersecurity (ENISA), fundamental rights (FRA) and law enforcement cooperation

(Europol – policing), the European Foundation for the Improvement of Living and Working Conditions (EUROFOUND – employment) and the European Data Protection Supervisor (EDPS).

In April 2021, the Commission submitted a proposal for an EU regulatory framework on artificial intelligence, the [artificial intelligence act](#), in which it adopted a horizontal approach to the subject. It proposed a 'risk-based approach' classification for AI systems with different requirements and obligations for each category established according to the estimated risks.

The proposal followed a reflection period during which the Commission issued a [white paper on artificial intelligence](#) highlighting the need for an approach with the twin objectives of promoting AI uptake and addressing the risks associated with certain of its uses. A resulting soft-law approach led to non-binding 2019 [ethics guidelines for trustworthy AI](#) and [policy and investment recommendations](#) written by the High-Level Expert Group on AI (AIHLEG) set up in 2018.

## European Parliament

Several committees, such as those on Culture and Education (CULT), Internal Market and Consumer Protection (IMCO), Industry, Research and Energy (ITRE), Legal Affairs (JURI) and Civil Liberties, Justice and Home Affairs (LIBE), have shown interest in and engaged in debates on AI issues. In September 2020, the Parliament set up a special [Committee on artificial intelligence in a digital age \(AIDA\)](#). It had 33 members, a 12-month term of office, and the mandate to analyse the impact of AI in the digital age on the EU economy. AIDA organised [hearings](#) on skills, employment, financial technology, education, health, transport, tourism, agriculture, the environment, defence, cybersecurity, industry, energy, gender equality and bias, democracy and e-government, and published [working papers](#). AIDA's [workshops](#) allowed an exchange of views among experts and stakeholders. In May 2022, it proposed an [EU roadmap](#) for AI and urged the EU, which lags behind in AI development, research and investment, to act fast to set clear standards based on EU values, as otherwise the standards would be set by others.

The Parliament has adopted resolutions addressing AI-related issues in the domain of [safety](#), transparency, bias and discrimination, [civil liability](#) providing legal certainty for businesses, [intellectual property rights](#), [guidelines for military and civil uses](#), and the use of AI by the [police](#). It has called for [common EU](#) rules on AI; these should be [human-centric](#), i.e. with human values such as fundamental rights, human dignity, natural environment and sustainability at their core.

Parliament's own initiative resolution on [AI in education, culture](#) and the audio-visual sector of May 2021 devoted a separate section to the application of AI in the cultural heritage domain, in which it described how AI can potentially contribute to the preservation, restoration, documentation, analysis, promotion and management of the tangible and intangible cultural heritage. AI monitoring and analysis of the changes happening to cultural heritage sites as a result of climate change, natural disasters and armed conflict, among others, could contribute to their preservation. Uniform databases with suitable classification schemes and multimedia metadata would enable researchers to make connections between different cultural heritage objects, and thus increase the knowledge about and understanding of the cultural heritage. The development, deployment and use of AI in customs screening procedures may support efforts to prevent the illicit trafficking of cultural heritage artefacts. AI technologies could also improve the accessibility of the cultural heritage, in particular for people with disabilities.

As co-legislator, Parliament is currently working on the Commission's proposed [AI act](#). Its IMCO and LIBE committees produced their draft joint report on the subject in April 2022; it received about 3 000 amendments.

## Museums and cultural heritage organisations

According to a 2021 museum innovation barometer, less than [20%](#) of museums across the world covered by the barometer reported they use AI for their collections, administration and management, education and finances. Yet, lockdowns during the coronavirus pandemic [changed attitudes](#) towards digital technology in museums and speeded up the digitisation of collections, the uses of technology and the reflection on ways to generate revenues with the help of digitisation.

In an open letter to the Commission on its consultation on digital technologies for cultural heritage, stakeholders such as Culture Action Europe, NEMO (the Network of European Museum Organisations), Cyprus University of Technology, VIMM, Michael Culture Association and UNESCO Cyprus therefore pointed to the need for pan-European and international standards, guidelines and methodologies for high-quality metadata taking into account all aspects of AI, intellectual property rights (IPR) and ethical issues, such as the transparency and accountability of algorithms, and the ownership, collection, storage, use and dissemination of data. The letter also highlighted the importance of digitising the cultural heritage while also developing technologies that would cut the CO<sub>2</sub> emitted in the digitisation and consumption of digitised content.

The [European Heritage Alliance](#) in its manifesto 'Cultural Heritage: A Powerful Catalyst for the Future of Europe' of May 2020, noticed that the pandemic had played a critical role regarding digital access to the cultural heritage and digitisation. It argued that digital transformation and the uptake of new technologies, in particular AI and machine learning based on humanistic and ethical principles, can democratise access to the cultural heritage and support diversity, inclusivity and creativity.

## AI and culture

The role of digital technologies, among others in the CCSs, has been recognised for some time now and was mentioned alongside the topic of EU digital sovereignty in the March 2021 communication on the [2030 Digital Compass](#): the European way for the Digital Decade. It is even more important for the CCSs, given their economic importance and the huge potential of EU creatives, who draw their inspiration from and contribute to rich European cultural resources but depend heavily on third-countries' technologies and platforms. US companies manage [90%](#) of the EU's data, and EU platforms represent only [2.7% of the global total value](#) of platforms, while ICT equipment, the [most common way](#) of accessing culture across the EU, is also produced outside of the EU. This is of concern, given that in 2021 the cultural and creative industries (CCI) employed 7.4 million people ([3.7% of the total workforce](#)) in the EU. There were 1.2 million CCI enterprises, most of which were either [SMEs](#) (employing less than 250 people) or micro enterprises (employing less than 10 people), with numbers varying according to activity.

In February 2022, the Commission published a [study](#) on the opportunities, challenges and risks of AI for the CCSs. It pointed to potential risks for cultural diversity and the need to ensure that AI provides a cultural offer reflecting the cultural diversity of the EU, as it is a [Treaty obligation](#) of the EU to preserve and promote its cultural diversity and history. The publication covers 10 cultural and creative sectors: architecture, book publishing, fashion, film, museums and the cultural heritage, music, news media, performing arts, visual art and video games.

To define AI, the study refers to the [description](#) used in the abovementioned proposal for an artificial intelligence act: 'a [fast-evolving family of technologies](#) that can contribute to a wide array of economic and societal benefits across the entire spectrum of industries and social activities'. The study adopts a 2019 definition by Caramieux et al., which [defines](#) AI as a 'set of technologies able to identify complex structures from massive datasets and to use these structures to make predictions and/or take actions and decisions on previously unseen data'. The publication focuses on a part of AI – machine learning, which seems to cover the most current uses of AI in the cultural and creative industries. In fact, the quoted publication highlights that the massive scale of daily creation, production, diffusion and consumption of texts, images, videos and sounds on online platforms

provides huge data sets to feed AI and let it 'learn patterns' from them. This is the reason why machine learning is the core of AI in the cultural and creative sectors.

Given the different needs, challenges and ecosystems of each cultural and creative sector, this paper focuses specifically on cultural heritage and museums.

## AI and cultural heritage data in the single market

AI operating across the EU relies on data that need to be part of the single market. Based on its February 2020 [European strategy for data](#), in February 2022 the Commission proposed a [data act](#), a regulation on harmonised rules on fair access to and use of data across the EU.

Both AI and data are part of the [Digital Europe funding programme](#), which provides funds for data [supporting ecosystems](#) dedicated to specific areas such as health, agriculture and culture. The programme works on the understanding that a [data economy](#) based on cultural data creates opportunities for jobs and growth. Its goal therefore is to develop a secure and trusted data space, but also to create a technical infrastructure combined with governance mechanisms that will secure easy, cross-border access to key datasets in the targeted area. Free flow of high-quality cultural heritage data in the EU is key for a successful development of AI related to cultural heritage and museums.

The importance of AI in cultural heritage reconstruction is obvious in the case of the destruction by fire of the Notre Dame de Paris cathedral. It is an example of how a digital product can contribute to the reconstruction effort thanks to an accurate [digital depiction](#) of the heritage building. Such an encounter of history with modernity is a cornerstone of digital preservation of the cultural heritage and a resource for AI uses.

In November 2021, the Commission published its recommendation on a common [European data space](#) for cultural heritage as part of its [Digital Decade policy programme](#), as already discussed in the communication on the [2030 Digital Compass](#): the European way for the Digital Decade. The document encouraged Member States to put in place frameworks to support cultural heritage institutions' efforts towards higher-quality digitisation, reuse and digital preservation, as a way to contribute to these sectors' recovery and transformation, as well as to the growth of other sectors such as tourism, research, and other cultural and creative sectors. The development of advanced digital technologies, such as 3D, artificial intelligence, machine learning, cloud computing, data technologies, virtual reality and augmented reality, has brought unprecedented opportunities for digitisation, online access and digital preservation. The document sets targets for the 3D digitisation of cultural heritage monuments and sites, but also for the attainment of digital-related skills by heritage professionals, and for the implementation of EU copyright provisions.

A common European data space for cultural heritage will give cultural heritage institutions the possibility to build on the scale of the single market, in line with the [European data strategy](#) outlined in a 2020 communication on A European [strategy for data](#). Thanks to high-quality content and efficient, trusted and easy access to European digital cultural heritage assets, AI should foster the reuse of content and spur creativity. Museums, galleries, libraries and archives will have possibilities to engage in collaborations and partnerships in the network of data partners, aggregators and experts working in the area of digital cultural heritage.

The European cultural heritage platform, Europeana, will serve as the basis for creating this common data space. Efforts will be guided by the Europeana [strategy for 2020-2025](#), which focuses on strengthening infrastructure, improving data quality and capacity, and empowering cultural heritage institutions in their digital transformation. The platform is also involved in [AI research](#) in cultural heritage projects.

## AI opportunities, challenges and cultural heritage data

Recently, the International Council of Museums (ICOM) [defined museums](#) as '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. [It] operate[s] and communicate[s] ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing'. UNESCO [defines cultural heritage](#) in a similar way: 'the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations'. It does not regard cultural heritage solely as an economic asset and a tourist attraction, but also as an identity factor and a contributor to social cohesion and stability. The fact that museums and cultural heritage have more than just economic importance sets them apart from other CCSs, which are market-oriented.

Museums and cultural heritage institutions across the EU are mostly state-funded public institutions. Not only does this assign to them a huge responsibility but it also limits their potential gains compared to the purely commercial cultural sectors that can invest their proceeds in new and expensive technologies and experiment with AI. This responsibility is even greater, given that [cultural heritage](#) is very important to 40 % of EU citizens and fairly important to another 40 %, according to a 2017 EU survey. According to the [European Museum Network](#), 10 out of 25 world museums are in the EU. Their huge collections can provide precious data for AI to both enhance visitors' experience and help museums manage their collections and [monetise the content](#).

### Challenges

In its February 2022 [study](#) – Opportunities and challenges of artificial intelligence technologies for the cultural and creative sectors – the Commission noted that cultural heritage institutions, similarly to cultural organisations, museums, film production companies and the music sector, are spending a lot of money digitising their collections and thus producing a large amount of metadata and data that, although technically accessible, are difficult to use because of legal barriers. Copyright is one of the major barriers, and it can hinder the decision to digitise items under copyright.

Another Commission study of February 2022 looked at [copyright issues](#) from a new technologies perspective. The authors focused on the potential use of new technologies to improve the management of data linked to copyright-protected content and to identify copyright data management challenges in the creative sectors. They also looked into the role of technology in managing rights. The study raised awareness about the importance of (meta) data and the need to increase the interoperability of metadata. Copyright poses a challenge to all CCSs.

The 2022 AI study on opportunities and challenges listed sector-related challenges, among them challenges museums and heritage institutions face in adopting AI. These include:

- a lack of awareness, availability of specific skills and knowledge among museum professionals, and the relative limited development of this area. The limited understanding of AI and the opportunities it offers, together with fear of the infringement of data protection or copyright laws, severely limits the uptake of the technology by museums and the cultural heritage sector;
- the level of digitisation of collections supported by high-quality metadata, since the richer and [better structured the metadata](#), the easier it will be to identify, find and then use the searched material;
- scarcity of funds, as well as wage imbalances between museum staff and specialised staff with AI competences;

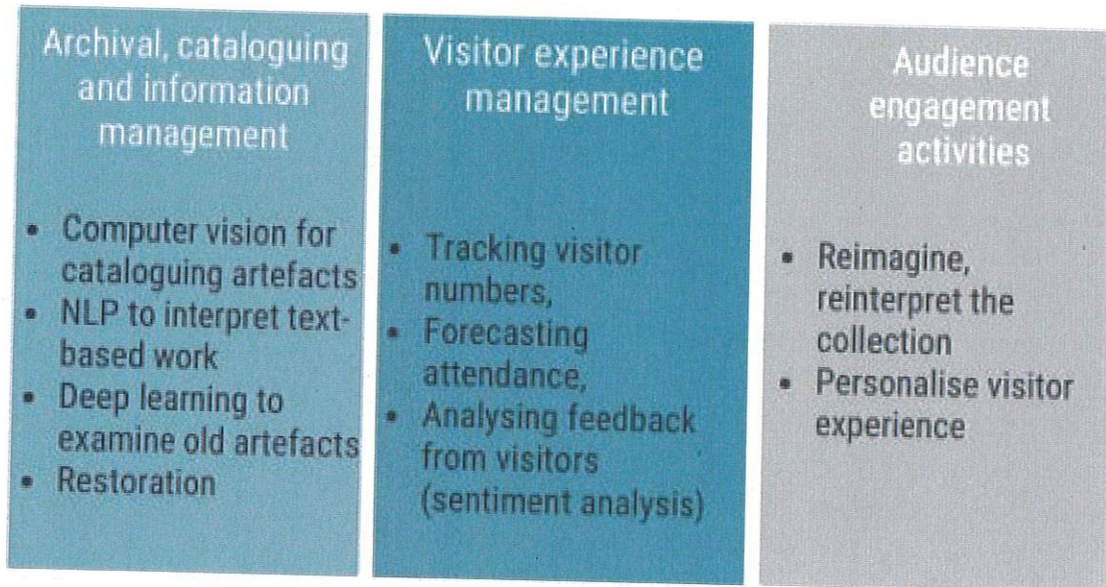


- the sector rarely uses AI to better understand audiences or to improve and inform the visitor experience. It furthermore has no clear vision of the commercial or business opportunities linked to the use of AI in museums and heritage organisations.

The above-mentioned challenges result in yet another one that smaller organisations face – investment risks and the resulting difficulty in accessing funding. Moreover, there is also the risk that such organisations might consider the need to invest in AI as less urgent.

## Opportunities

Figure 1 – The opportunities offered by AI to museums and cultural heritage institutions



Source: Commission study on Opportunities, and challenges of artificial intelligence technologies for the cultural and creative sectors, 2022.

The low level of digitisation undertaken by small museums and collections would appear reasonable, since the process requires considerable resources in terms of both finance and staff. After all, the heritage sites and artefacts acquired and exhibited by museums remain predominantly experienced by visitors present in situ. As museums and cultural sites had not massively digitised their collections or applied AI, the restrictions that came with the pandemic forced them to close their premises (95 % of world museums) and halt their activities. This led to job losses and permanent closures. Since then, given the intense online cultural activities by users and various cultural institutions, the situation has changed. At least 15 % of all museums increased their digital activity as part of an overall trend to further adopt and supplement location-based activities, with no ambition to replace physical and in-person experiences with digital activity and audience engagement.

The 2022 Commission AI study lists the following opportunities AI offers to museums and the cultural heritage:

- archival, cataloguing and information management applications enhanced by AI, which will help museums, archives, libraries and cultural heritage institutions to research and categorise digital collections more effectively;
- AI-assisted audience engagement activities, which will help to better communicate and engage with audiences, making interactive exhibitions more engaging;

- visitor experience management, which will help better manage museums and cultural heritage venues using AI applications; this will help track visitor numbers, forecast attendance, and analyse feedback from visitors (sentiment analysis). The São Paulo museum is an example of such an initiative.

## EU funding for AI use in cultural heritage and museums

EU funding supporting AI use in cultural heritage is available through various programmes, such as the [Horizon Europe](#) research programme, [Digital Europe](#) and the [Erasmus](#) programme, and [funds](#) such as the cohesion policy funds, REACT-EU, the Technical Support Instrument and the Recovery and Resilience Facility. The Creative Europe programme also offers some support through its [Creative Innovation Lab](#), which develops [solutions for the cultural and creative sectors](#) based on cultural heritage. In addition, the European Regional Development Fund can contribute to AI projects in preventive conservation of cultural heritage, as shown by the [ART-RISK](#) project in Spain.

## Future developments

Recent developments in AI and its acceptance by cultural heritage institutions and museums create a positive environment for its deployment. First, the coronavirus pandemic showed the need to digitise museums and heritage sites, and then the Russian war against Ukraine and the massive destruction of the country's cultural heritage pointed to the urgency of creating digital cultural heritage archives. AI can help with both running these tasks and managing the processes, and then with making use of such data for the benefit of the public.

The EuropeanaTech Task Force listed in its [report](#) the tasks that lie ahead for AI implementation. These include:

- integrating new AI systems developed in research projects into existing systems;
- publicly sharing and generalising models trained on cultural heritage collections;
- implementing AI in a way that is considerate of ethical, legal and social aspects;
- reducing the carbon footprint of training models and processing at scale.

Moreover, the EU cultural heritage data [recommendation](#) obliges Member States to report every 2 years on their progress in 3D digitisation of their monuments and sites, training and capacity building. However, the process is complex and requires preliminary steps such as solving copyright issues. The path to reaching the benchmarks can be long also from a technological point of view, as costly infrastructure and equipment are needed, while priorities seem to point in the direction of energy transition, inflation and security issues.

In addition, recent developments in [generative artificial intelligence](#) have created a huge variety of opportunities for the cultural and creative sectors that use cultural heritage content as a basis for their activities. It could also have implications for cultural heritage institutions and museums. As [Europeana](#) suggests, AI, such as [Markov chains](#), and artificial neural networks, such as [GPT-3](#) (Generative Pre-trained Transformer 3, a deep learning model) can produce text or content that in turn might become part of collections in galleries, libraries, archives and museums, as such items gain appreciation and are considered a new form of 'creative' expression'. As another form of creative activity by AI, they pose questions of copyright.

[ICOM](#) (International Council of Museums), which organises conferences and encounters devoted to digital technologies in museums, notes, 'In our new digital culture, users increasingly become producers of their own content and technologies like artificial intelligence make individualized experiences the normality. This changes the way [people engage with museums](#). Audiences are no longer satisfied with top-down content and demand a higher level of inclusion, participation and interactivity'. This major change, which has already started, will have a huge impact on how museums and cultural heritage institution will function and engage with visitors.

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