Artificial Intelligence for the Protection of Archaeological Heritage: Policy Gaps and Opportunities in European Union and UNESCO Frameworks

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Abstract: Artificial Intelligence (AI) and its tools are starting to hold an undeniable place in our lives. Every day, new tools and software are being incorporated into various fields, with cultural heritage being one of them. In particular, archaeology is a unique case of AI applications as it is a traditional and delicate domain with numerous peculiarities. Hence, this thesis aims to explore the ways that cultural policies control the integration of AI into the domain of archaeology and suggest future directions for it. This research starts by building an extensive theoretical framework to reveal the interrelatedness between archaeology, AI, and cultural policies. Then the thesis employs qualitative content analysis to analyze 10 policy and industry documents released by the European Union and UNESCO. The documents were selected through purposive sampling and were coded thematically using Atlas.ti to identify trends and gaps related to AI governance and innovation in tangible and archaeological heritage management. The analysis was strengthened by the mini case study of the Archaeological Park of Pompeii to ground the findings in a real-world context through discussing the AI applications there from the same analytical lenses. This investigation reveals that even though AI is recognized as a transformative tool in heritage conservation due to its benefits, such as public engagement and conservation, there is a significant sector-specific policy gap regarding AI utilization in archaeological heritage. Policies emphasize the significance of digitization, ethics, free access, and equality; however, they remain too broad and fragmented and more suggestive than enforceable. Pompeii, while showcasing the advantages of AI, also highlights the absence of interoperability standards and shared ethical guidelines. This results in a need for horizontal and comprehensive archeology-specific cultural policies to primarily close the existing policy gap and ensure equal conditions for the digital transformation of cultural institutions. This thesis adds to the intricacies of cultural policy by providing more dynamics and dilemmas to be managed to ensure the success and sustainability of both AI and archaeological heritage. The ultimate goal of this thesis is to serve as a foundational tool to interpret the current landscape and a charter for its future by making AI's benefits and challenges in archaeology explicit.

Keywords: Archaeological Heritage, Artificial Intelligence, Cultural Policy, Digital Heritage Governance

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1. Introduction

Technology has always been a transformative tool in the history of humankind, from carrying astronauts to space to connecting everyone globally with smartphones. Today, this progression is unparalleled as machines and algorithms capable of emulating human intellect and skills, known as Artificial Intelligence (AI), are being developed. Recent tests revealed that AI systems have consistently become more capable and are now beating humans in tests in domains such as reading comprehension, handwriting recognition, language understanding, predictive reasoning, and more (Roser, 2023; McKinsey & Company, 2023; Roser, 2022). This rapid evolution of technology not only transforms daily life and industries but also how societies understand and protect their cultural heritage.

Among cultural heritage sectors, archeology stands out as a venue for AI, since the field is defined by its vast amount of data and its dependency on high levels of human and financial capital. Concerning AI's potential to retain and connect large volumes of data, and deliver time and cost-efficient restoration interventions, it is becoming a progressively adopted tool. However, there are severe ethical, environmental, and financial limitations counterbalancing these advantages. These include ethical concerns about biased or decontextualized historical narratives, environmental damage from AI's energy consumption, and the high financial costs of implementing advanced technologies into an already underfunded sector like cultural heritage. These challenges raise ongoing debates about ensuring that AI applications in archaeology respect heritage's cultural, historical, and emotional complexities (Tenzer et al., 2024).

Even though there are no established answers to these dilemmas, AI is increasingly used in archaeology. This ambiguity, combined with AI's potential to reshape cultural heritage's fabric for better or worse, requires conversations and measures on the political-economic level of this domain, which necessitates responses at the cultural policy level (Tsimitakis, 2024).

This thesis, therefore, aims to analyze the dynamics between innovation, mainly AI, and regulation in the invaluable field of archaeology. To answer the question "How do current cultural heritage policies address the challenges of using artificial intelligence in archaeological heritage preservation, and how might they be improved?", ten different European Union and UNESCO cultural policy and industry documents are analyzed through qualitative document analysis to reveal the shared regulatory approach. To do so, the intersections of AI, tangible cultural heritage, and archaeology in these different documents are investigated.

Based on this, the thesis is structured into six chapters, starting with the theoretical framework on relevant literature, which provides definitions for tangible cultural heritage and AI, investigates their overlap, and discusses the qualities of cultural policy to establish the basis of the investigation. Subsequently, the third section focuses on the Archaeological Site of Pompeii, Naples, and illustrates real-life AI applications, though it does not serve as the central case study. The fourth chapter describes the methodology used for the research by exploring the data collection processes, the suitability of the qualitative content analysis, and the reliability of the study. The fifth section presents the results of the 10 policy documents in different themes and connects the findings back to Pompeii from a regulatory perspective. Ultimately, chapter six synthesizes and summarizes how governing bodies balance archaeological heritage's sensitivities with AI's complexities, and suggests directions for future research.

My recent trip to Pompeii served as an inspiration for this thesis as I encountered references of AI use in the archeological park and questioned how such innovations are regulated within the broader policy framework. Therefore, I am grateful that this thesis allowed me to combine my personal and academic interests in innovation, cultural heritage management, and cultural policies.

2. Theoretical Framework

2.1 Cultural Heritage

2.1.1 Defining Cultural Heritage

Cultural heritage is fundamental on individual, regional, national, and global levels due to its centrality in human conditions such as intellect, morals, and psychology. Its intrinsic and economic value makes it something to be safeguarded and promoted (Panzera, 2022). National, international, and non-governmental institutions define it from various perspectives. For example, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has dedicated itself to protecting world cultural and natural heritage, which they define as "... our legacy from the past, what we live with today, and what we pass on to future generations. Our cultural heritage and natural heritage are both irreplaceable sources of life and inspiration." (UNESCO, n.d.).

On the other hand, the European Commission, the European Union's (EU) main governing body, defines cultural heritage as "Europe's cultural heritage is much more than a repository of knowledge; it is also a shared resource, and a common good. Heritage makes a major contribution to defining the identity of European citizens and is a resource for social

cohesion and economic development." (European Commission, n.d.; European Commission, 2014). While UNESCO adopts a collectivist perspective, and the EU a Eurocentric one, both emphasize that cultural heritage has an outstanding value that encompasses a society's or a social group's unique spiritual, material, intellectual, and emotional characteristics, builds a sense of identity on various levels, is transgenerational, and is globally valued as it is (Harvard University Department of History of Art and Architecture, n.d.).

Defining cultural heritage is a complex and evolving concept. In 1972, UNESCO published the Convention Concerning the Protection of the World Cultural and Natural Heritage, with the approval of twenty-two countries, to create a consensus on cultural and natural heritage protection across the globe. This convention remains essential even today as it established the framework for protecting significant heritage sites and provides a basis for defining cultural heritage (Harvard University Department of History of Art and Architecture, n.d.). It limits cultural heritage's scope to monuments, architectural groups of buildings, and sites (UNESCO World Heritage Convention, 1972).

This definition recognizes that cultural heritage encompasses historical and artistic traits alongside relational, environmental, and geographical variables, and assigns normative significance to these factors (Panzera, 2022). This reinforces the idea that culture is an adaptive product, actively shaped and sustained by societies over time (Jaeger & Selznick, 1964).

Another contribution of this definition is the establishment of Outstanding Universal Value (OUV) which is the utmost level of cultural significance assigned to the aforementioned heritage types (UNESCO World Heritage Convention, 2019). For UNESCO Member States, the ratification of OUV meant adopting global responsibility for heritage protection, alongside their national commitments, which manifests UNESCO's mission to build long-lasting peace following the mass destruction of the World Wars (UNESCO, n.d.).

Through this definition, UNESCO refined the meaning of the word 'heritage' as (1) generational, placing the responsibility of protection on current generations for the future; (2) transnational, establishing it as a global concern for all humankind; and (3) anthropologically broader, encompassing the human interaction with cultural objects (Abdulqawi, 2023). Nonetheless, the definition that has laid the foundations for cultural heritage protection has some shortcomings. Primarily, aesthetic and anthropological perspectives are not applied consistently among the several perspectives applied to the classifications, which makes the definition insufficient (Hua, 2010). Moreover, the monument-focused perspective is criticized for disregarding not only the cultural processes and spatial, temporal, and social dimensions

of cultural heritage but also intangible heritage (Abdulqawi, 2023; Levi-Strauss et al., 1995). These limitations highlight a paradox in UNESCO's approach: it attempts to attach an outstanding, global value to heritage while overlooking intangible heritage due to a Eurocentric approach.

This has led to the expansion of the definition of cultural heritage over time (UNESCO World Heritage Convention, n.d.). A major step taken by UNESCOi where Member States agreed to share the responsibility of respecting, safeguarding, and promoting intangible cultural heritage like tangible cultural heritage was the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage. Intangible cultural heritage was defined as practices, expressions, skills, and related cultural objects and spaces that communities recognize as a part of their cultural heritage. This was followed by an emphasis on community transmission and a list of domains including oral traditions and expressions, performing arts, social practices, rituals, festivities, indigenous knowledge and practices, and traditional craftsmanship (UNESCO, 2003). This convention was a response to the growing concerns revolving around globalization and social change as well as UNESCO's Eurocentrism (Dewi et al., 2025; Vecco, 2010).

However, this definition received mixed responses from scholars. Some believe that it captured the liveliness and broadness of intangible heritage. Another school of thought find it vague, unscientific, and limited (Dewi et al. 2025; Francioni, 2020).

Despite the mixed criticism, the 2003 Convention marked a transformative shift from the static preservation of only tangible heritage to the active transmission of living heritage to other generations. In 2009, UNESCO further unified both categories of cultural heritage, intangible and tangible, and classified the latter into movable, immobile, and underwater heritage (UNESCO Institute for Statistics, 2009). This approach, despite the specific domains of each type of cultural heritage not being fully defined, offers a much more inclusive and comprehensive take on cultural heritage, as it recognizes its diverse values and highlights them across classifications.

2.1.2 Values of Cultural Heritage

The reason behind these definitions and classifications is that cultural heritage is exceptionally valuable for a range of reasons. Primarily, it is intrinsically valuable as it is produced and made meaningful by collective efforts over time. This intrinsic value consists of two parts: historic value and inherent value. The historic value captures the historic significance of the location and its potential to transmit past values and meanings through

generations, like a living memory. The inherent value is the manifestation of the unique blend of physical and spiritual aspects that gives significance, value, emotion, and mystery to cultural sites (Roszczynska-Kurasinska et al., 2021). Whether it is to endow the younger generations with the knowledge, customs, and cultural practices or to ensure the continuity of a community and their sense of identity, the bequest value of cultural heritage gives it an unprecedented power to promote intergenerational continuity (Dümcke & Gnedovsky, 2013; Klamer, 2013).

In addition, cultural heritage also holds deep social and psychological value, promoting belonging and sustainable forms of living (Dümcke & Gnedovsky, 2013; Panzera, 2022). These elements shape both the physical experience and emotional attachment of an individual to a place (Roszczynska-Kurasinska et al., 2021), positioning heritage as a resource vital to human well-being at both individual and societal levels.

Cultural heritage also plays a key role in economies. The economic value of cultural heritage can be described as the welfare, both material and immaterial, generated by a heritage. This value consists of direct financial benefits/income, such as tourism income, and non-market benefits such as intrinsic values. The economic values and non-material values of cultural heritage are deeply interconnected. For example, contingent valuation is an economic tool that is used to measure an individual's willingness to pay for the recreational use or conservation of an object or site discarding their interaction. It can capture the non-use value of heritage, like in the case of the bequest value, i.e., the welfare derived from the knowledge that the heritage will be passed on to future generations (Ruijgrok, 2006; Klamer, 2013).

Investing in cultural heritage can also generate other social benefits and most imporantly, it can favor economic growth and create new jobs, especially in the tourism sector. Labor-intensive restorations are a paramount example of business activities that can generate employment opportunities. Additionally, improved site quality and infrastructure benefit industries such as tourism and gastronomy, leading to further investment. Cultural legacy also enhances a location's desirability, attracting competent workers, firms, and travelers, thereby providing it with a competitive advantage. Overall, public investment in cultural assets can act as a catalyst for the revitalization of the larger area, attracting domestic and international corporate investments. Ultimately, cultural heritage not only preserves the legacies of the past but also contributes to promising pillar for sustainable growth by blending tradition with innovation and providing diverse social and economic benefits (Dümcke & Gnedovsky, 2013).

2.1.3 Archaeological Heritage and Its Specificities

A type of cultural heritage that truly displays the aforementioned values is archaeological sites. An archaeological site is a place of an important event, a prehistoric occupation or activity, or a building or structure, whether standing, wrecked, or missing, underground or underwater, where the area itself has historic, cultural, or archeological significance, regardless of its worth of any surviving structure. These sites are distinct types of tangible cultural heritage as they carry information and knowledge about how humans lived, suffered, worshipped, built and destroyed, survived, and perished, and can share these with or without written records, with bones, tools, sculptures, and more. They are non-renewable witnesses and collectors of the physical traces of the journey of mankind, making their preservation critical as a testament to the past and the future of humanity (Matero et al., 1997/2012; Demas & Agnew, 2013; Pennsylvania Historical & Museum Commission, n.d.).

The preservation of archaeological heritage requires the use of non-destructive techniques such as satellite imagery and remote sensing while avoiding physical disruption. Conservation focuses on the protection of the site's physical fabric against erosion and deterioration, using both preventive or interventive methods like structural stabilization, reconstruction, building protective structures, or reburial. These choices often involve tensions between opposing scientific, associative, and aesthetic values (Demas & Agnew, 2013; Matero, 2004/2012). However, there is a second layer of friction, as excavation is an invasive process that is both ruinous and irremediable (Mackay & Sullivan, 2012). Hence decision-making requires countless experts from different fields, such as archaeologists, anthropologists, historians, art historians, and conservation professionals, to guide this process (Demas & Agnew, 2013).

The management of archaeological sites also requires multiple stakeholders, as it is a complex branch that encompasses various elements. The site not only needs expert care to preserve its essence but also has to administer functions such as tourism, landscaping, water management, financial management, collaborating with residents, and developing solutions to meet the needs of regional government, international bodies, and different ministries, all without losing the cultural value. This aspect of archaeological site management is becoming increasingly critical to ensure the long-term preservation and sharing of cultural assets. To battle this, the institutions have to be interdisciplinary and conscious of both the significance of that heritage and the factors that are impacting the site (Mackay & Sullivan, 2012; Demas & Agnew, 2013).

Unfortunately, this is not the only challenge of archaeological site management. By their nature, these sites often carry significant political and ideological weight. As it is an extremely valuable source, there are frequent conflicts about its ownership and interpretation for different cultural, national, international, and religious reasons (Demas & Agnew, 2013). Archaeological knowledge has been and can be instrumentalized by different actors to create and validate specific narratives to fulfill their agendas. Moreover, they are highly affected by national and global economic and political conditions in which they are. While the political context could alter how archaeological heritage is treated and represented, and position it as state propaganda, the surrounding economic pressures could prioritize commercial interests and compromise the site's cultural value, integrity, and preservation (Araya, 2024; Ababneh, 2021). This is a significant problem against the objectivity of history that the managers and experts on the site have to govern.

Moreover, the global standardization of cultural heritage conservation practices may conflict with local traditions and values. The cultural contexts of the communities involved have to be acknowledged and taken into consideration to protect the site's authenticity. The protection of its original cultural significance would also be a way to protect the site against commercialization (Ababneh, 2021). The economic value of the site should exist as a complementary factor to the other values of the heritage and not overtake them. This is an intricate balance that has to be protected since, in the end, the economic value relies on a site's cultural and social values (Demas & Agnew, 2013).

Archaeological sites are exposed to increasing threats from natural and human-made risks. There is a never-ending list of challenges, encompassing natural disasters, climate change, mass tourism, exhaustive urban development, war, looting, and ideological constraints. As the world is becoming globalized, highly populated, and consumption-oriented, there are increasing efforts to protect the cultural heritage with innovative techniques. Not only archaeological sites, but all cultural heritage is worth protecting as it sheds light on the past, present, and future (Demas & Agnew, 2013). It requires attentive individuals, experts, and communities to balance scientific, social, historical, economic, and political factors. As these threats are expanding, it is essential to implement sustainable, future-oriented, and bold practices to protect these resources, especially at a time when traditional conservation methods cannot match the pace of required maintenance.

Since the Industrial Revolution, the conservation of tangible cultural heritage has mainly been based on traditional manual techniques, such as cleaning, varnishing, repair, and restoration, which rely on the physical interventions of specialized experts. However, these

manual conservation practices often cannot compete with the rapid degradation of tangible cultural heritage, as they are both time-consuming and costly. Furthermore, the lack of clarity on some methods can result in an irredeemable loss, while over-restoration can also lead to destruction. The prioritization of heritage sites or objects based on their touristic value or the personal judgment of the restorer introduces an element of subjectivity into the process (Li & Tang, 2023; Gaber et al., 2023). Alongside these limitations, catastrophic events such as the ongoing war in Palestine and the fire at Notre Dame have highlighted the urgent need for upgraded preservation methods (Pansoni et al., 2023). This is why Artificial Intelligence (AI) has become relevant since it offers an unmatched capacity and efficiency in digitizing and conserving large collections of art and historical artifacts (Gaber et al., 2023).

2.2 Artificial Intelligence and Archaeology

2.2.1 Defining Artificial Intelligence

To understand the integration of Artificial Intelligence (AI) into archaeological heritage, it is necessary to explain it first. AI refers to a machine's ability to exhibit human-like traits, including creativity, learning, thinking, and planning. Its technical systems enable the computer to perceive the environment, gather data from it, process that data, and respond in a way that achieves the specific goal that was instructed (European Parliament, 2020). The idea of AI emerged in the 1950s from the question “Can machines think?” and since then it has evolved into elaborate systems capable of performing increasingly complex tasks in a sophisticated, flexible, and multifaceted manner that can be applied to numerous fields (Stryker & Kavlakoglu, 2024).

AI's intentionality, intelligence, and adaptability (West & Allen, 2018) position it at an unrivaled place among digital technologies and innovations. To fully grasp AI's scope and avoid interchangeable use it is important to distinguish it from digital transformation, digitalization, and digitization. Digital transformation refers to integrating digital technologies that alter how businesses operate, deliver value, and adapt through constant innovation (Verhoef et al., 2019). Digitalization refers to changing the socioeconomic environment through the adoption, use, and application of digital artifacts, while digitization involves the production of those digital artifacts through technical conversion, representation, and enhancement procedures (Gradillas & Thomas, 2023). Although these concepts enable the transfer of data and cultural objects to digital environments, AI represents machines autonomously learning from data and adapting over time, exhibiting cognitive characteristics that were once considered unique to humans (West & Allen, 2018).

Key branches of AI include machine learning, natural language processing, computer vision, neural networks, deep learning, and cognitive computing. They guarantee the constant evolution and progress of AI, like generative AI, which has advanced into a tool that can produce complex original content from sounds to videos. These branches give AI a unique assortment of skills and capabilities such as object identification, pattern recognition, robotic process automation, predictive analysis, 3D modeling, and more (Srinivasaiah, 2024; Zohuri & Rahmani, 2019; Stryker & Kavlakoglu, 2024; Andriole, 2018).

AI systems can create one large integrated web of knowledge that can be directly connected and accessed by computer systems without any interventions. Moreover, when managing the data, they can diminish human cognitive biases that can distort information processes as they are considered more stable and neutral than humans. When combined with AI's near-light-speed processing pace and the automation of processes, there are significant cuts in costs and time, giving more time to professionals to focus on other tasks (Korteling et al., 2021; "Artificial Intelligence vs. Human Intelligence," 2024). These features promote the use of AI in different domains.

2.2.2 Artificial Intelligence in Archaeological Heritage

One of these rising fields is cultural heritage conservation. Preserving cultural heritage is essential in protecting and promoting the stories of societies. However, with natural and man-made evolving threats, traditional conservation methods are falling short in doing so (Avcı, 2023). As discussed, tangible cultural heritage is immensely exposed to the effects of climate change, time, wars, intense urbanization, and more. AI is advancing every day alongside these threats and it is not only being increasingly utilized to solve pre-existing problems but also to guarantee the future of cultural heritage (Pansoni et al., 2023; Avcı, 2023; Eyadah & Odaibat, 2024).

These challenges have incentivized the integration of AI into heritage conservation to offer new chances for conservation and engagement with heritage (Pansoni et al., 2023; Avcı, 2023). Some of the key applications that have increased the accuracy, efficiency, and accessibility of cultural heritage are as follows:

- 3D Scanning and Modelling: AI facilitates the creation of highly detailed 3D models of historic objects, sites, and structures, which enables the virtual exploration and the digital preservation of cultural heritage (Eyadah & Odaibat, 2024).
- Virtual and Augmented Reality: AI-powered virtual reconstruction and restoration enable precise and detailed reproductions of historical sites and objects, providing

immersive, interactive, and engaging experiences (Pansoni et al., 2023; Eyadah & Odaibat, 2024).

- Data Mining and Pattern Recognition: AI can help find hidden patterns and trends within cultural heritage data, to help and enlighten experts (Avcı, 2023; Eyadah & Odaibat, 2024).
- Computer Vision for Restoration: AI can restore degraded cultural items and structures by filling the missing sections, minimizing cracks, and improving color. When the results are combined with pattern detection algorithms, AI also facilitates the assessment of degradation levels to provide more evidence for judgments on conservation methods (Avcı, 2023; Eyadah & Odaibat, 2024).
- AI-Assisted Archiving and Classification: AI can automatically identify objects in cultural heritage collections and organize metadata relating to them. This ensures that crucial information is maintained with the items themselves (Pansoni et al., 2023; Eyadah & Odaibat, 2024).
- Geographic Information Systems (GIS) and Predictive Analytics: When integrated with AI, GIS can contribute to preventative preservation initiatives through mapping and managing cultural heritage properties, evaluating and managing environmental changes, natural catastrophes, or climate change (Eyadah & Odaibat, 2024).
- Robotics and Drones: AI-enabled robots and drones can be used for site inspections, maintenance, and surveillance activities to lower the chances of damage or vandalism at cultural sites (Eyadah & Odaibat, 2024).
- Authentication and Fraud Detection: AI can increase the integrity of cultural objects by authenticating items and detecting fraud in the art market (Eyadah & Odaibat, 2024).

These tools have altered various cultural sectors such as museums and archives. Yet, their uses in archaeology have proven particularly helpful and revolutionary, to the extent that it is thought to be the cornerstone of all cultural heritage conservation activities (Ge, 2024). The broadest use of AI in archeology is for extensive planning through automated scheduling and budget estimating, concurrent activity tracking, and predictive excavation planning of the depth of a site and the possible objects through machine learning (Avcı, 2023; Ge, 2024). Traditional ways of treating records and data are often inconvenient and error-prone, due to missing, inaccurate, or cluttered data, which results in suggested irregular correlations (Mantovan & Nanni, 2020). In response to this, AI can be combined with light detection and

ranging technology to scan archeological sites to map them as they are and locate potentially underground objects. This integration can fill the gaps in point cloud data, improving 3D modeling and facilitating the identification and classification of architectural elements (Pansoni et al., 2023; Ge, 2024).

One of the most prominent uses of AI is for object reconstruction and virtual restoration of cultural sites and objects, especially through Generative Adversarial Networks (GANs). GANs are a type of AI consisting of two systems that work against each other: as one creates new content, the other distinguishes between real and synthetic data. Through this repeated process, the system learns to produce increasingly realistic results. There can be enhancements to the (virtual) restorations and reconstructions of frescoes, paintings, ceramics, and coins (Gattiglia, 2024; Tiribelli et al., 2024).

Lastly, AI supports the meaning-making of archeological data by recognizing items and placing them chronologically, interpreting information, and directing users on what to read (Gattiglia, 2024). These advancements highlight AI's growing role in making archaeology more precise, accessible, and sustainable amid complex conditions and large-scale data.

2.2.3 Associated Risks

Despite AI's transformative potential in cultural heritage conservation, its applications present fundamental ethical concerns and limitations. A leading concern is cultural and historical bias, specifically as metadata and training data, because when cultural heritage is being recorded and deciphered through AI models, there is the risk of ignoring or dominating the history of underrepresented races or groups. This is especially pronounced as most digitization procedures are administered with top-down regulations that tend to omit various factors concerning the interested parties. Especially when concerned communities do not have enough resources to manage their heritage on their own, these biases can skew and flatten the interpretation, completely exclude the population, and reinforce cultural appropriation and exploitation (Tiribelli et al., 2024; Pansoni et al., 2023). Consequently, AI’s Western-centric dataset can challenge the sensitivity and nuances of different cultures (Penn State, 2024).

The authenticity of cultural heritage is also at risk from AI. Tangible cultural heritage, whether objects or sites, is inherently human as it blossoms from human creativity and labor; therefore, the reliance on computers to reconstruct these works is highly doubted by experts (Ghaith & Hutson, 2024). For example, even if digital replicas are extremely immersive, they are not considered to be representative of the original (Pansoni et al., 2023). Moreover,

professionals believe that AI, especially generative AI, must be able to justify its decisions against the claims of manipulating the work's uniqueness and aesthetics (Tiribelli et al, 2024). However accurate and detailed the result is, there is a shared concern about losing the sacredness and uniqueness of cultural artifacts, due to AI's incapability to comprehend the intrinsic value of heritage. Hence, the centrality and the irreplaceability of the physical sites have to be emphasized (Pansoni et al., 2023).

Another area of concern is economic inequality. The access and implementation of AI technologies demand substantial economic investment and exceptionally skilled experts. This could impede the education and cultural access for all at low-cost mission of cultural institutions, as it imposes a business-oriented approach. This also risks a further imbalance between larger and wealthier organizations and smaller organizations that cannot afford such high costs. On a more global scale, that would lead to the prioritization of different sites and cultures over others, without any justification. Economically disadvantaged countries are more likely to be treated as "B-list cultural heritages" simply because they do not have enough means to integrate AI for reconstruction and preservation (Pansoni et al., 2023). On the other hand, the displacement of employees from cultural institutions to be replaced by mechanisms boosts inequality in the labor market. As AI technologies are mostly centralized within a few large tech companies, this can create monopolies in regulating infrastructures, know-how, and data access, again undermining smaller organizations and countries (Kulesz, 2024). Additionally, privacy and data governance concerns arise when utilizing AI. The simplicity of sharing and modifying digital files makes it difficult to preserve the personal data they contain and assess their accuracy. Moreover, online access to cultural heritage was not highly anticipated, especially in the past, hence it was not explored as a possibility with the informants or benefactors (Pansoni et al., 2023). Privacy and data governance are essential elements that need to be covered, as every user has the right to be informed about how their data is treated.

Lastly, the accountability and explainability of AI must be addressed. As explainability is a precondition for accountability, the results and the processes must be comprehensible "to non-technical users such as art historians, archeologists, and communities.". To set the balance between AI and humans, it is necessary to determine whether the algorithm may be considered an ethical actor, or if its creators and users are the only ones liable for its behavior (Pansoni et al., 2023). To avoid AI becoming a black box, its role and purpose must be explicitly stated in a language that all actors can comprehend.

Overall, AI is a groundbreaking tool for cultural heritage preservation as it is actively reshaping the sector by offering various algorithms and tools for documentation, restoration, authentication, discovery, and accessibility. However, there are growing risks entitled to AI ranging from historic bias and authenticity issues to economic inequality and data governance. Policies are effective tools to address this imbalance because they provide structured, enforceable frameworks that align with technological advances and cultural responsibility. Since cultural heritage carries immense values, stories, and identities, policies can set clear boundaries to safeguard these assets. The following section will explore the definition, scope, types, and changes in cultural policies.

2.3 Cultural Policy

2.3.1 Defining Cultural Policy

Cultural policy is a concept that has been continuously evolving and shaping the way institutions govern and fund cultural life since the 1940s (Bell & Oakley, 2014). Most broadly, cultural policy can be defined as the government's activities and approaches regarding the arts, both profit and not-for-profit, humanities, and heritage, as a form of public policy (Mulcahy, 2006; Bell & Oakley, 2014). These activities entail a wide and diverse set of stakeholders, institutions involved in promoting the creation, production, display, transportation, and conservation of heritage and artistic activities and products (Mulcahy, 2006), making it a complex tool.

An intricacy of cultural policy is that it covers both symbolic and strategic functions. Culture, as discussed, is a tool to create and nurture memory, identity, and belonging alongside economic and social outcomes (Mulcahy, 2006; Panzera, 2022). Similarly, cultural policy is there to both preserve cultural heritage and to provide equal access to culture. Cultural policy is dependent on time, place, and political dynamics and is a reflection of political, economic, historical, and societal value systems. On one hand, this can be beneficial for society through responding to the needs of the sector, for example, in recent years, economic drivers such as the prosperity of cultural industries, their revenue, and job generation capacities have been prioritized. On the other hand, this makes cultural policy a biased administrative tool that can be exploited by power dynamics of institutions, governments, and global pressures (Bell & Oakley, 2014; McGuigan, 2004; Dubois, 2015). This ambivalence is inherent in multiple aspects of cultural policy.

The implementation of cultural policy is one of these features, which varies considerably in its approach. The top-down approach is a hierarchical and vertical model that

favors specific types of culture that were recommended by experts or elites as the preferable types of culture for the public. Contrarily, bottom-up cultural policies emphasize participation, diversity, and decentralization to achieve a more representative and democratic cultural landscape (Mulcahy, 2006; Dubois, 2015).

This shift towards a more inclusive and interactive understanding of cultural policy put cultural heritage in the spotlight as the heritage list expanded to natural and industrial sites beyond the traditional definition (Dubois, 2015). This extension matches the democratization of culture and cultural policy, recognizing that heritage is not only inherited but also is created and negotiated, like the 2003 UNESCO Convention where intangible heritage was brought to international attention, changing the scope of cultural policies (Mignosa, 2016).

However inclusive and varied heritage is, its vitality and power prevent its neutrality. Heritage is an active force, sometimes mobilized to support specific national or international ideas to reflect the chosen values from the past to carry to the future (Schofield, 2015). It embodies ideological struggles such as superstar heritages, disregard for minority cultures, whose memory is preserved in what way, and how power is exercised (Mignosa, 2016). This is stimulated further as cultural policy systems are shaped by each country's historical processes of nation-building and distinctive governance models (Dubois, 2015). Consequently, heritage policy is not only about preservation but is about cultural representation, political legitimacy, and administrative tasks.

The complexity of governance consistently escalates as there is a growing number of institutional stakeholders, ranging from national governments, private parties, local authorities, and international organizations. These actors shape heritage objectives and precedents through policy design, funding, regulation, and implementation (Mignosa, 2016). This transforms heritage governance into a negotiating environment influenced by political cultures, institutional arrangements, and socioeconomic priorities. In addition, international and supranational organizations such as UNESCO and the European Union, in European countries, have become prominent. Their norms and financial arrangements influence national agendas, perpetuating the notion that cultural heritage policy is a local and global entity.

2.3.2 Cultural Policy's Actors

UNESCO's influence on cultural heritage policy has been substantial as it has created and diffused cultural policy on a global level, starting with conventions to define cultural

heritage and establishing frameworks to follow it in practice. Especially through its promotion of cultural diversity, it has championed the development of national cultural policy infrastructures across the Member States. The organization employed strategies such as peer pressure to encourage the adoption and creation of cultural policies. By promoting early adopters, UNESCO facilitated a chain reaction, motivating neighboring countries to follow this trend. This has institutionalized cultural governance at the national level through the creation of cultural policies unique to nations' cultural values (Alsauutari & Kangas, 2020).

The organization has also fostered a shared vocabulary and framework for discussing cultural policy, creating a common understanding of cultural heritage independent from their individuality, without imposing strict legal obligations on the Member States, which are also known as soft law. UNESCO, while providing meticulously produced recommendations with series and numbers for cultural policy, leaves the decision to implement it to the nation-states and relies on their commitment, reinforcing soft law. Overall, by encouraging countries to follow their unique cultural policy strategy but encouraging them to adhere to the international standards for unity, UNESCO changed the approach to cultural policy and gave it a universal platform (Alasuutari & Kangas, 2020; Silvia, 2015).

Instead, the EU has emerged as a rather important political and economic entity, nurturing both regional and European identity as well as economic development. For the EU, at first, culture was a source to establish a European identity, hence became a visibly strategic tool. Particularly, after the Treaty of Maastricht in 1992-1993, the EU has implemented measures for cultural integration, such as establishing new governing and funding bodies that shape cultural activities and promote a shared identity (Mitter, 2024). The EU's cultural governance is characterized by a multilevel governance system, where power and influence are exercised through networks linking public and private actors at regional, national, and European levels. The constant interaction among various stakeholders and different European Union bodies allows the exchange of continuing developments and thus the agenda-setting for cultural policy (Dewey, 2010).

Furthermore, the EU has adopted the Open Method of Coordination, a form of soft law which "is a form of intergovernmental policy-making that does not result in binding EU legislative measures and it does not require EU countries to introduce or amend their laws" (European Union, n.d.), institutionalizing exchanges on Member States' cultural policy-making and adapting best practices (Mitter, 2024). In this framework, the EU's cultural policy is based on symbolic recognition, financing channels, strategic collaboration, and promotion rather than legal enforcement (Bell & Oakley, 2014).

Regardless of their approaches, the European Commission has identified cultural sectors, such as cultural heritage, as vital for economic development in a global knowledge-based economy. Recognizing cultural heritage is integral to the EU's broader cultural objectives (Dewey, 2010). Additionally, the EU's approach to cultural heritage protection involves close collaboration with organizations like UNESCO to provide more coherent guidelines to safeguard cultural heritage on various levels (Braman, 2010).

Still, the governance of cultural heritage remains complex. Institutional fragmentation within cultural policy can create both innovation and ambiguity. On one hand, the involvement of many institutions can lead to unique and locally adapted solutions, and a better understanding of the landscape and relationships in the cultural policy field (Singh, 2010). On the other hand, it can create ambiguity regarding policy implementation, governance, and roles if there are overlapping or discarded responsibilities (Littoz-Monet, 2012). This duality is evident in the EU's multilevel system, where different actors interact across levels using soft governance methods, allowing flexibility and innovation alongside ambiguity in compliance (Van Der Ploeg, 2005).

2.3.3 AI & Cultural Heritage Policy

A factor that is highly contributive to this duality is digitalization and the integration of digital tools, especially AI. As discussed before, AI technologies are revolutionizing the way cultural heritage is handled, whether it is 3D scanning or language decoding, opening a new era in cultural management and hence cultural policies (Avcı, 2023). Even if it is a novel field, there is a pressing need for cultural policies that address the implications of AI in cultural heritage, as it is not only about protecting cultural heritage but also about ensuring fairness and transparency regarding data collection. These gaps are trying to be filled in by different stakeholders with local initiatives, but it is time and money-consuming as there are few resources to be allocated to several fields such as governance, ethics, and social integration of AI (Gattiglia, 2024; Jin, 2021).

Archaeological heritage is one of the cultural domains where the lack of regulation is a growing concern because effective preservation is a global responsibility, yet the fragmentation and variety of laws that differ significantly across countries impact the success of management efforts (Eze-Uzomaka, 2014). As illustrated before, archaeological heritage intrinsically has some challenges, such as narrative creation, economic exploitation, tourism, and the absence of a standardized approach due to the uniqueness of each site (Demas & Agnew, 2013). AI, being increasingly used in this field, is overcoming some of these issues

regarding preservation but is raising new questions about technicalities, finances, ethics, biases, and generalizations. Moreover, the application of AI in this context is no longer limited only to experts since it has become a tool of accessibility and education for non-experts also (Jin, 2021; Gattiglia, 2024).

It has been acknowledged that international cooperation is an essential component of global and cohesive AI governance, to protect the cultural heritage in question as well as the myriad of stakeholders involved. This has prompted international players, such as UNESCO and the EU, to facilitate discourses on shared guidelines of AI and its application to cultural heritage. For example, UNESCO published a Recommendation on the Ethics of AI, which is the first-ever global standard that proposed policy measures to cover data governance, international collaboration, gender, ethics, and more. Or the EU has established new governing and funding bodies, as well as measures to further promote the integration of culture and technology, as a part of their broader cultural objectives (Kulesz, 2024).

Overall, cultural policy is an evolving concept that is navigating multiple tensions, such as conflicting values and differing hierarchical institutional approaches. In addition, new dynamics are emerging as cultural policies must now consider the rising popularity of AI applications in archaeology. Both UNESCO and the EU are exploring these developments from different perspectives, working to provide guidelines that match the rapid pace of technological advancements. To further illustrate the applications of AI in archaeology and its intersection with cultural policies, a mini-case study will now be presented.

3. Pompeii as a Mini Case Study

To provide a real-life example for the upcoming policy analysis, this chapter presents the Archaeological Park of Pompeii. While the discussion here is mainly descriptive, the case will be revisited later to contextualize and reflect on the findings.

Located in Naples, Italy, Pompeii is a unique and outstanding site that was a Roman town in 79 CE before Mount Vesuvius exploded and buried the town in volcanic ash. The excavation started in the 19th and 20th centuries and still unravels new information, artifacts, and edifices that were kept intact under the ash. Pompeii holds the potential to be labeled as the richest archaeological site on earth, with its volume of data available to experts. The research on the site requires meticulous work and precision, as the site is highly fragile and irreplaceable (Cartwright, 2018). The site's vulnerability by itself requires special heritage management practices; however, due to both manmade and natural threats, the site requires strategic risk management and conservation plans (Petti et al., 2024). To eliminate these

threats to some extent and to reconstruct the past, the Archeological Park of Pompeii decided to adopt AI into their practices.

The park, with the initiative of the Italian government and EU funding, designed and began the Great Pompeii Project (GPP) from 2012 to 2022 as a critical scheme of interventions for the preservation, protection, reconstruction, and enhancement of Pompeii's archaeological site (Parco Archeologico di Pompei, n.d.). The model accounts for multi-scale and multi-level approaches to provide quick assessments of emergencies, create a list of priorities, and allow for expert and in-depth examinations of well-known concerns. In particular, there are three assessment levels: local assessment level undertaken by specialist teams annually to assess the site's condition, general assessment level conducted monthly by experts through utilizing drones and AI techniques to assess the overall condition of the site, and detailed assessment level carried out to assess and resolve the findings of the other assessment levels. In this case, AI is used as the primary site monitoring tool to observe changes and assess criticalities through machine-learning activities. This places AI at the center of the project as a decision-making tool, as expert intervention is dependent on its analysis. Moreover, its monthly evaluation builds an archive of the site, capturing the consequences of natural factors and expert choices, and ensuring transparency regarding the site's changes. This reliance on AI for the archaeological park's emergencies and monitoring puts responsibility on both the algorithm and the experts who train it to ensure that the concerns are prioritized fairly and that the site is observed extensively (Petti et al., 2024; Ossana & Rinaldi, 2017).

Another project undertaken by the park is the rePAIR project, which uses machine learning and 3D computer vision to reassemble frescoes in Pompeii. It is co-developed with Pompeii’s heritage experts, combining historical and archaeological data, to reach sub-millimeter precision for geometry and high-resolution texture details. The resulting dataset is one of the first of its kind to address real-world archaeological conditions, such as unevenly shaped, eroded, and fragmentary parts, making it a technological and heritage milestone. Archaeologists contributed critical metadata such as artistic style, material, and contextual information to aid in training and assessing AI models, which also helps consider the cultural nuances. This initiative balances automatic reassembly and expert verification, highlighting the significance of human control. The project has been revolutionary in repairing degraded surfaces on each fragment, resulting in an even better alignment and a more consistent surface, finishing puzzles with missing pieces that were lost or irreversibly destroyed during the collapse. However, the team expresses ethical concerns about digital forgeries, the misuse

of open-access datasets, and the absence of norms for 3D watermarking or cultural accountability, and emphasizes that AI can never replace human expertise. Moreover, the risk of AI re-narrating the frescoes when put together furthers the ethical concerns. This project carries more risk of causing irreversible harm to the archaeological site than the GPP, underscoring the importance of implementing robust cultural policies governing AI training, data creation, and ethical standards (Tsesmelis et al., 2024).

Lastly, archaeologists and computer scientists have collaborated to virtually reconstruct Casa Del Centenario, a big house with multiple frescoes in Pompeii, from 79 AD to 2002 (Planet Pompeii, n.d.). This wide timeline of virtual reconstruction captures and presents every decision taken regarding the excavation and preservation of this house, ensuring precision and transparency. The extremely detailed digital reconstruction has enabled archaeologists to test their hypotheses and interpretations dating back to the original state of the house. This has also allowed visitors to evaluate the theories and the interventions through multiple hierarchies and viewpoints without any mediators, increasing the site's educational value. Overall, this project has advanced the virtual reconstruction processes and public engagement with archeological heritage. This protects the degraded heritage in an alternative platform and also paints a complete picture for both archaeologists and visitors (Scagliarini et al., 2001).

Pompeii exemplifies AI's groundbreaking potential in archaeological heritage management, with its applications ranging from site management to meaning-making for experts and the public. While these projects demonstrate the AI's capability to enhance preservation and accessibility, they also raise critical ethical and governance concerns, including the need for unbiased AI algorithm training, human oversight, and a coherent approach to digital transformation across the domain. To explore this complex interplay between AI, archaeological heritage, and cultural policies, this thesis will address the research question, "How do current cultural heritage policies address the challenges of using Artificial Intelligence in archaeological heritage preservation, and how might they be improved?". The following section will outline the methodology used to examine the existing cultural policies, particularly those of UNESCO and the European Union, to investigate the current landscape.

4. Methodology

4.1 Research method and design

This master's thesis aims to explore the growing integration and framing of AI in current cultural heritage policy, particularly archaeological heritage. To do so, qualitative document analysis is the most appropriate tool as it provides the researcher with the perspective and the interactions of the actors involved in the phenomenon. Moreover, it enables a detailed inspection of strategic and normative texts, unraveling content and what is emphasized, omitted, or obscured. This potential to discover discursive patterns and governance priorities makes it a tool to study policy documents from a meaning-making perspective on both a European and global level (Bryman, 2012). This qualitative document analysis adopts an abductive method as it starts from concepts and themes from the theoretical framework, and then extends them to real-world applications with a thorough analysis of policy papers and publications (Vila-Henninger et al., 2022). Since AI in cultural policy is a rapidly and constantly evolving field, this type of research aims to build a pathway between theory and data (Stewart, 2025).

For the qualitative content analysis, policy and industry documents are the most suitable sources for empirical research, as they reflect the history, context, debates, issues, options, and stakeholders regarding political and regulatory developments. The term policy and industry documents, in the context of public policy, contains legal texts, press releases, reports, and papers produced by public sector agencies or affiliated stakeholders. These documents are also more easily available, efficient, and cost-effective (Karppinen & Moe, 2019). Hence, this research can unravel how AI and archaeological heritage are regulated on the policy level and reveal areas of strength and weaknesses that are necessary to maintain the sustainable development of this field.

4.2 Data collection and sampling

Qualitative document analysis requires data selection rather than data collection because there are numerous and highly available documents (Bowen, 2009). At the beginning of the research process, since this thesis covers AI, tangible cultural heritage, and archaeological site management, there was a broad range of documents. To narrow it down to those most relevant to the research question, purposive sampling, in particular criterion-based sampling, was used (Bryman, 2012).

The documents were included if they were published by UNESCO, European Union institutions, or affiliated political bodies to ensure the governing aspect. Moreover, the

documents had to address at least one of the topics of theoretical frameworks: tangible cultural heritage management with a preferred focus on archaeological heritage and AI, or AI policies with a focus on heritage management. They also had to represent strategic, legislative, or technical perspectives (e.g., policy briefings, recommendations, regulations, declarations, or reviews). Lastly, they had to be published in the past 15 years, ensuring alignment with the contemporary landscape of AI-related transformation in the heritage sector.

Documents were excluded if they only focused on education, media, or creative industries without any connection to tangible heritage, or if they discussed AI without mentioning cultural, historical, or heritage-related uses. Lastly, if they were either outdated, highly technical, or lacking policy relevance, they were discarded. However, certain documents, like the Artificial Intelligence Act by the European Parliament and Council, were kept, even though they have a wide scope because of their significance both to the public and to this study.

The sampling follows a general-to-specific logic, starting with broad documents on AI governance, moving to tangible cultural heritage applications, and narrowing further to archaeological heritage management, to reflect the multi-level intersections of these concepts.

These criteria resulted in 10 policy and industry documents being picked, covering policy reports, conference proceedings, regulations, normative recommendations, and research reports published by EU bodies and UNESCO. The uneven distribution, eight from the EU and two from UNESCO, creates an asymmetry in the sample. This is attributed to differences in policy activity, as the EU has released more documents specifically addressing AI and tangible cultural heritage, whereas UNESCO's contributions tend to be broader in scope and less frequent, resulting in fewer documents that meet the inclusion criteria.

While the UNESCO documents were collected from the UNESCO Digital Library, the EU documents were mostly collected from EUR-Lex, which is managed by the publication bodies of the EU. For the EU bodies' documents, the European Heritage Hub's Policy Monitor was utilized as it maps out all the policies across Europe that influence cultural heritage at the European, national, and local levels (European Heritage Hub, n.d.). This ensured the authenticity and credibility of the documents, which are important for document quality (Bryman, 2012). The final set of selected documents with the publishing body, title, and year can be seen in *Table 1*.

Title of the document	Publishing body	Type of document	Approval year
Laying Down Harmonised Rules on Artificial Intelligence and Amending Regulations	European Parliament and of the Council	Legislation	June 2024
Recommendation on the Ethics of Artificial Intelligence	UNESCO	Normative recommendation	November 2021
UNESCO World Conference on Cultural Policies and Sustainable Development – MONDIACULT 2022 (28-30 September 2022, Mexico City)	UNESCO	Policy declaration	September 2022
Policy Review 2nd Report: February - July 2024 Digital Transition Policies in Europe's Heritage Sector	European Heritage Hub	Policy report	2024
Recommendation on a Common European Data Space for Cultural Heritage	European Commission	Policy recommendation	November 2021
Research for CULT Committee - The Use of Artificial Intelligence in the Cultural and Creative Sectors	Caramiaux, C for European Parliament Committee on Culture and Education (CULT)	Research Report	2020
Artificial intelligence in the context of cultural heritage and museums: Complex challenges and new opportunities	Pasikowska-Schnass, M., & Lim, Y. S. For European Parliament Directorate - General for Parliamentary Research Services	Research briefing	2023
Artificial intelligence in education, culture, and the audiovisual sector	European Parliament	Policy Texts Adopted	2021
Amersfoort Agenda – Setting the agenda for the future of archaeological heritage management in Europe	European Archaeological Council (EAC)	Conference Proceeding	2014
Memorandum of Understanding for the implementation of the COST Action "Managing Artificial Intelligence in Archaeology" (MAIA) CA23141	European Cooperation in Science and Technology (COST)	Policy Memorandum	2024

Table 1- Document Sample - Ordered From General to Specific

4.3 Data analysis

Qualitative document analysis, focused on meaning-making rather than quantification, is employed to analyze the documents. The documents are treated as discursive constructs,

reflecting strategies and norms, rather than merely factual data. Coding serves as this step since it creates certain themes and subjects to analyze the text accordingly. It entails deconstructing, analyzing, comparing, interpreting, and organizing data into categories (Bryman, 2012).

To facilitate and systematically code, organize, and group the findings, Atlas.ti was utilized. The study followed semi-deductive coding as it mostly relied on a theory-driven approach but allowed the emergence of new themes and codes (Puppis, 2019). The key codes were adapted from the operationalization of the theoretical framework. The theoretical framework highlighted what to focus on within the policy documents, such as recurring themes of ethical concerns. It assisted in directing attention to the most relevant content of the analysis. For example, the theme "Artificial Intelligence Governance and Ethics" refers to AI policies, ethical guidelines, and governance mechanisms within the documents. Codes under this theme include titles such as "transparency and accountability, ownership and control in AI systems, or bias and discrimination", to help identify discussions about AI in tangible heritage and the role of policy that had been mentioned in the theoretical framework. Therefore, each section of the theoretical framework was treated as a broader theme, and the peculiarities, reasons, strengths, or concerns discussed created the codes for it. In addition, when necessary, quotations were coded with multiple themes and codes to display the interconnectedness of different elements.

Flexibility and adaptability were kept to accommodate the emergence of new themes and codes. Codes were assigned based on the reoccurrence of words as well as the cues about how an issue was framed and its implied meaning or how much they were emphasized. For example, passages which were discussing the absence of interoperability standards and the need for harmonized standards across various levels were coded with "policy coherence" even though the term itself was not used. This approach allowed the analysis to be both structured and open, capturing the embedded data about policy that had not emerged before in the theoretical framework.

Each document was thoroughly read and coded according to the predetermined set of thematic categories. These codes focused on the interpretation of context and meaning of the policy and industry documents rather than the repetition of codes, to evaluate this novel field better. As codes were amassed, they were sorted into larger categories and themes that reflected the interplay of AI technologies, cultural heritage governance, and archeological preservation. A total of 41 codes were grouped into 4 themes covering AI governance and ethics, innovation in tangible heritage protection, archaeological heritage focus, and cultural

policy elements. This coding structure and application are exemplified in *Table 2*, and the complete coding structure can be seen in *Appendix A1.* Codes were systematically managed and refined using Atlas.ti, allowing both structured organization and the emergence of new analytical insights. This approach enabled the identification of the current focuses and gaps of policy papers alongside their future directions.

Codes	Theme	Example from a source
AI Governance	AI Governance & Ethics	"The definition should be based on key characteristics of AI systems that distinguish it from simpler traditional software systems or programming approaches and should not cover systems that are based on the rules defined solely by natural persons to automatically execute operations." (Artificial Intelligence Act, EU Commission)
Human-centric AI	AI Governance & Ethics	"The Commission supports the development of human-centric AI that respects human rights and values." (Research for CULT Committee Report)
Heritage Digitization	Tangible Heritage Preservation & Innovation	"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." (Artificial intelligence in the context of cultural heritage and museums)
Data Space for Cultural Heritage	Tangible Heritage Preservation & Innovation	"Digital transition is crucial to prevent the irreversible loss of Europe's cultural assets at risk from climate change and other disasters." (Policy Review: Digital Transition in Heritage, EU Heritage Hub)
Archaeology in Education and Awareness	Archaeological Heritage Focus	"As most threats to archaeological heritage are caused by a lack of awareness about the values of archaeological remains to society as a whole, it would seem beneficial to invest in integrating archaeology into education at an early stage." (Amersfoort Agenda, European Archaeological Council)
Best Practices and Knowledge Sharing	Archaeological Heritage Focus	"Develop a shared understanding across the network around international best practices for identifying and leveraging comparative collections and creating training data for AI applications." (MAIA COST Action – Managing AI in Archaeology)
Digital divide	Cultural Policy Elements	"Efforts should aim at closing the digital divide in the cultural sector to ensure equitable access to heritage resources." (Policy Review: Digital Transition in Heritage, EU Heritage Hub)
Open access	Cultural Policy Elements	"Data generated through publicly funded digitization initiatives should be made openly accessible for research and innovation." (Recommendation on a Common European Data Space for Cultural Heritage, EU Commission)

Table 2 - Examples of the Themes, Codes, and Excerpts Demonstrating the Logic

While the formal coding was applied to the selected policy and industry documents, the mini case study of Pompeii was analyzed from the same thematic lenses with a more interpretive focus. The materials related to Pompeii such as project reports, articles, and descriptions were investigated from the four thematic perspectives arising from the analysis.

This approach enabled to reflect on how the dynamics discovered in the policy analysis manifested themselves in practice.

4.4 Quality of the Research and Limitations

This study has several limitations that should be mentioned. Regarding data collection, the primary limitation is that only 10 documents are analyzed, with eight of them from EU bodies and two of them from UNESCO. Even though they are some of the biggest influences in cultural policy, this might exclude some national or local initiatives and not capture all the nuances of AI policy development in cultural heritage. Also, there is a lack of specific AI in archaeology documents; therefore, some of the documents tie into the research from the broader scope of tangible heritage or culture. Yet, this limitation is acknowledged as an indicator of a developing policy scene.

Moreover, there might be institutional bias as they may reflect strategic and idealized versions instead of underrepresented perspectives or challenges being faced. This could alter the results and create an unrealistic policy agenda. On the contrary, the current policy landscape might have been misinterpreted. Concerning sampling, the criterion-based sampling and the publication bias might have excluded important documents because they did not fit institutional categories or were too broad, and hence, diminish the current state.

Additionally, qualitative document analysis involves the researcher's interpretation to some extent. Choices about which passages to code and how to categorize them are inherently subjective, even if a systematic software is used. Lastly, as it is a rapidly developing field, some of the analyzed documents might become outdated, or new policies could be put into force.

However, most of these limitations are counterbalanced as chosen documents are collected from two of the most important and forward-looking actors in the policy field. Also, the analysis is strongly grounded in the theoretical framework, which provides a coherent, systematic, and theoretically grounded approach to examining how AI and archaeological heritage are positioned in current cultural heritage policies. Ultimately, the novelty of this phenomenon could also be an advantage and result in strategic and broader suggestions to ensure AI’s productivity in archaeological heritage.

5. Findings and Discussion

5.1 Introduction

This chapter discusses the findings of the EU and UNESCO document analysis regarding AI in archaeological heritage. Due to the novelty of the field, documents were interpreted through two lenses: how AI is framed and governed in the context of archaeological and tangible heritage, and, in cases where archaeology or tangible heritage was not explicitly mentioned, how archaeological heritage or tangible cultural heritage is (in)directly addressed in AI-focused documents. In the latter cases, the analysis explored how extensive AI-related frameworks influence archaeological practices through elements such as transparency and ethical design.

The chapter is organized into the themes that emerged through a semi-deductive coding strategy and were refined using Atlas.ti during the reading process. While the findings are drawn from patterns in co-occurrence and thematic emphasis, they are interpreted through their discursive and regulatory implications.

This chapter aims to highlight the strengths, contradictions, and possibilities for future cultural policy, drawing back to the case of Pompeii, an internationally governed, data-rich archaeological site where AI is actively applied to contextualize the findings.

5.2 AI Governance, Ethics, and Policy Gaps

As AI is a complex tool that is being increasingly used across sectors, both UNESCO and the EU have started to approach AI as a transformative technology that demands ethical frameworks and policy interventions to foster innovation while mitigating its social, legal, and knowledge-based risks. These institutions have primary regulatory frameworks for AI that represent the evolving definitions of AI, principles of transparency and accountability, and approaches to risk classification, which all carry important implications for heritage domains. Before exploring AI's place in cultural policy, this section examines how these documents frame AI as an object of governance, what mechanisms are proposed to manage its development and deployment, and how these choices fit or shape the needs of sensitive fields such as archaeology. It will start with a differentiation between the EU and UNESCO's approaches to AI because even though the focus of this thesis is not the institutional differences, the variations are worth mentioning.

The Artificial Intelligence Act (Directive 2024/1689) is the primary and most comprehensive European regulation on AI, which provides guidance and mentions the penalties entitled to improper use. Even though this document is not explicitly tied to

archaeology or tangible heritage, it is fundamental for every aspect of life that AI affects and also carries the potential to become a global standard. In the document, the EU defines AI as a machine-based system that autonomously generates outputs like content, predictions, or decisions that affect physical and virtual conditions. This definition combines various AI applications under one term, signaling flexibility and functionality for the expected developments.

Then the definition is followed by the differentiation of high-risk systems and general-purpose AI. The former concerns the uses of AI in biometrics, critical infrastructure, education, vocational training, employment, workers' management, essential private and public services and benefits, law enforcement, migration, border control, and judicial acts, which are all considered to carry significant risks to health, safety, and fundamental rights. AI applications in (archaeological) heritage fit into the latter as these applications are classified as general-purpose AI since they repurpose adaptable, large-scale AI models for specialized, domain-specific tasks such as reconstruction, conservation, or interpretation, without being inherently high-risk or systemic. This classification creates the central tension regarding AI in (archaeological) heritage as it diminishes the risks associated with AI applications in cultural heritage.

As discussed in the literature review, these risks could lead to irrevocable consequences. For example, the inherent biases in heritage interpretation could get heightened with AI's biases and alter cultural narratives, ignore underrepresented cultures, or any wrong decision/execution by AI could permanently damage the non-renewable and one-of-a-kind remains. Moreover, categorizing applications in heritage as a non-threat to fundamental rights is contradictory to the statement, that access to culture and participation in cultural life are considered fundamental human rights, globally essential public goods that must be placed at the highest policy level, claimed in "Council conclusions on improving and fostering access to culture" legislation (Information and Notices 2024/7446). Therefore, by classifying these applications as general-purpose, the EU overlooks the unique vulnerabilities, values, and rights being breached, and the long-term societal implications of AI in culture.

On the other hand, the Recommendation on the Ethics of Artificial Intelligence is UNESCO's first global standard on AI ethics, applicable to 194 Member States (UNESCO, 2024). In the document, UNESCO does not provide a precise definition of AI, stating that any definition must evolve with technological advancements. Instead, it characterizes AI as a

group of information-processing technologies that can execute cognitive tasks with increasing autonomy and focuses more on the ethical, societal, and environmental consequences of AI.

While the EU's framework is more legally focused on AI regulation, UNESCO adopts a value-driven model of soft law. This difference could be related to their geographical scope, as the EU covers fewer countries and strives for a single market in every aspect, UNESCO aims for global collaboration by incentivizing countries through "peer pressure".

In the document, UNESCO dedicates a section to culture and heritage as areas that require ethical attention. It encourages the Member States to utilize AI to enhance the preservation, understanding, promotion, management, and accessibility of tangible, documentary, and intangible heritage. Yet, they are urged to consistently examine and address the cultural impact of these systems to modify them according to the risks they pose to maximize AI's benefits. Even if UNESCO focuses more on supervising AI in culture and anticipates harm across various sectors, it does not offer enforceable frameworks, which leaves the adoption of recommendations to the discretion of the Member States. Still, the EU offering the procedures and penalties, and UNESCO suggesting the values necessary to regulate AI, are complementary and highlight two sides of an emerging governance framework.

Nevertheless, the EU and UNESCO, across all AI-mentioning documents, stress certain qualities of AI that should be pursued regardless of the domain to develop trustworthy and sustainable AI. These attributes include ethical, value-based, transparent, accountable, and human-centric AI. Ethical AI refers to fair and reliable AI systems that are aligned with fundamental rights and social values. Value-based AI further links AI to societal objectives such as justice, equity, peace, and environmental sustainability. Transparency and accountability represent AI systems need to be explainable and traceable regarding their purpose, inputs, and outputs. Lastly, human-centric AI ensures that AI serves people rather than replacing them, prioritizing human input, oversight, and judgment. Together, these qualities shape a normative framework that encourages trust, protects rights, and orients AI systems toward public benefit.

However, these principles must be evaluated through ethical assessment tools and criteria to ensure consistent application and support context-sensitive interpretations. The documents stress the involvement of diverse stakeholders, from AI developers to cultural policy experts and the public, in shaping ethical AI practices and particularly tackling bias and discrimination. To develop the tools and applications for people, it is necessary to incorporate numerous diverse perspectives. Another ethical reinforcement is through

developing due diligence and oversight mechanisms to identify, mitigate, and prevent the risks associated with human rights; however, except for broad references, there is no practical direction on how these evaluations should unfold in practice.

Pompeii illustrates this absence of shared ethical values and procedures in archaeological heritage, as there were no mentions of coordinated structures to evaluate compliance with ethical standards or the values UNESCO and the EU both promote, even though ethical concerns were stated. This reveals that AI in archaeological heritage is governed more by expert consensus than field-specific ethical tools. In the two most important AI regulation documents, none of the institutions exclusively address the effects of AI on tangible or archaeological heritage, which is inherently vulnerable to bias, whether through fragmented data or culturally embedded narratives.

Ultimately, the EU and UNESCO have taken fundamental steps in regulating AI, legislatively and normatively. They acknowledge that AI encompasses not only algorithms and data but values, actors, and infrastructures, making its ramifications political, ethical, and civil, and have established the elements AI has to possess and how they can be managed. However, these efforts remain on paper without set oversight mechanisms, especially concerning archaeology and heritage, where clear and tailored policies are absent. Like in the case of Pompeii, it proposes a gap between AI policy and field-sensitive mechanisms. Nevertheless, the institutions' encouragement towards implementing AI in these sectors has to be recognized. This duality of governance challenges and initiatives becomes more evident when examining how innovation is approached in tangible heritage preservation.

5.3 Innovation in Tangible Heritage Management

It was mentioned that archaeological heritage falls under the broader title of tangible cultural heritage. To better comprehend the state of cultural policies overseeing AI in this domain, the policy shift toward reliance on digital technologies has to be discussed. The EU and UNESCO urge countries to use digital tools to document, manage, protect, and promote physical heritage assets to improve their access, sustainability, and disaster resilience. To incorporate AI to achieve these goals, the policy papers first call for digitization and data enhancement. This is also a prerequisite stated in Pompeii's rePAIR project, as the project's success in reassembling frescoes depends on the quality and accessibility of digitized archaeological data. This section focuses on and reaffirms the ties between tangible cultural heritage, digitization, and AI, through policies.

In the analyzed documents, the primary goal of digital transformations was revealed to be easier, increased, and guaranteed access to cultural objects and data through applications ranging from the digitization of artifacts, using digital tools to promote culture, and using AI to enhance preservation and management methods. Currently, the EU and UNESCO prioritize digitizing cultural assets for two goals: creating a data space and AI integration.

Creating a shared data space for digitized content is important for digital preservation, as it disperses various threats like degradation and disasters, through offering a collective space. Moreover, as it increases awareness about which object belongs to where it can track online trade of cultural property and add another layer of physical protection (Information and Notices 2021/7953; MONDIACULT-2022/CPD/6). It also allows heritage to reach wider audiences by eliminating physical boundaries. At the EU level, this contributes to achieving a single cultural market that benefits all European citizens and cultural institutions, explaining their affirmation of this space (Pasikowska-Schnass & Lim, 2023). Furthermore, digitized cultural heritage is associated with spillover effects in other key sectors, such as tourism, research, and other cultural and creative sectors, therefore, the stored data would allow reusing heritage for new products and services (Information and Notices 2021/7953). Digitization and creating an open space for these artifacts is deemed crucial for both the benefit of the artifacts and the cultural sector overall.

When taken to the AI level, heritage digitization, open access to this data, and AI are highly intertwined in tangible heritage applications. While the free flow of high-quality heritage data is seen as the key to the successful development of AI in cultural heritage, AI is seen as a tool that can catalog and explore connections between data and personalize it for users, representing the mutuality of these elements. This interplay sets digitization as the primary and employs AI as the end goal, as the success of AI depends on high-quality digital data.

Yet, AI goes beyond the scope of digitization in this domain by monitoring illicit trafficking of cultural objects, analyzing the reactions to environmental factors, managing tourism in cultural and archaeological sites better with data processing, and democratizing access to cultural heritage for people with disabilities. What emerges from policy analysis is that, beyond innovation, responsible AI is seen in a dynamic cycle of usage in heritage protection, fostering citizen welfare through accessibility, sustainability, and inclusivity, which in turn establishes more effective and novel heritage policies. This endorses the further development and adoption of AI tools, illustrating a circular relationship between AI

governance, heritage management, and societal impact, and an inseparable tie between application and policy. Accordingly, ethical and inclusive AI in tangible heritage is not recommended only for improved preservation but for a more prosperous society through cultural participation and innovation.

Even though there are many benefits attached to the promotion and reliance on digitized heritage and AI tools, there are also emerging policy concerns about open data and copyright. While one of the primary reasons for digitizing data is to make it more accessible, there have to be frameworks that ensure its openness and interoperability, providing fair access and honest use of heritage. These currently unavailable frameworks are crucial for the advancement of digital tools because they depend on large and structured datasets; if the datasets are not coherent, it could lead to biased and incomplete interventions that could be irreversible.

On the other hand, copyright is stated to be in place to facilitate the availability and reuse of cultural data. However, copyright is restrictive by nature and leads to further divides between applications, especially in institutionally isolated fields like archaeology. Despite its limitations, it is crucial to avoid manipulating the object and its narratives by other parties. This is an important duality since the availability, quality, and openness of cultural data directly shape the possibilities, effectiveness, and risks of AI applications in heritage management. When combined with open data issues, the analysis reveals the need for policies that respect the origins and ownership of digitized data, just like the necessity for boundlessly accessible and exchangeable data.

However, these aren't the only problems as digitization and AI reveal new policy problems, such as digital (il)literacy, unequal access to technological infrastructure, and varying levels of AI readiness. These are fundamental issues that must be addressed at the cultural policy level to ensure a foundational digital transformation in cultural heritage. The analysis disclosed the tendency to involve different stakeholders, establish public–private partnerships, and share digital skills to tackle these inherent divisions. Yet, these approaches and their implications for capacity-building will be explored in Theme 4.

Ultimately, digitization's and AI's potential and limitations in tangible cultural heritage are highly recognized. There are ambitious policies, starting with digitization, to provide a smoother transition to AI utilization. However, tangible cultural heritage is a broader term and while it provides a valuable context, archaeological heritage requires more targeted policies to address its unique challenges. The next section will explore these distinct needs in greater detail.

5.4 Archaeological Heritage Focus

As discussed before, archaeology is a sub-category of tangible heritage, and it tends to get bundled in general references. By combining the collected data from the broader themes with the limited number of documents addressing AI in archaeology, this theme explicitly investigates its unique challenges, practices, and policy needs.

To begin with, in the policy documents, it is repeated that archaeology has distinct data specificities due to its interpretive and fragmentary nature. Archaeologists face a challenge in defining archaeological data because they work with remains that have survived through time, shaped by both intentional and unintentional actions of past and present communities, as well as by human and nonhuman forces. In addition, interpreting this incomplete heritage depends on different theoretical approaches. There is an inherent paradox: the data merely comes with what has been and has to be discovered, while simultaneously being shaped by human interpretation (Gattiglia, 2024). The Amersfoort Agenda highlights that data is not the same as knowledge, indicating that standardizing access to data does not necessarily produce discoveries about the past (European Archaeological Council, 2015), which challenges the advocacy for open-access data. It conveys that interpretation and human oversight in archaeology will remain central to transforming fragmented, context-dependent data into knowledge, which is one of the biggest impediments to the digital transformation in the sector.

These interpretive challenges become more pronounced when archaeological data is treated by AI systems. As discussed before, AI systems are not capable of understanding nuances related to history and culture, limiting their contextual interpretation. Therefore, when they are given inherently incomplete and subjective data, algorithms can create critical issues for the integrity of archaeological work. Moreover, while it is possible to provide trainable datasets for AI to overcome some of the interpretation problems, there is a lack of sufficient data, and some of the existing data is not machine-operable. When combined with the sensitivities of archaeology, utilizing AI could lead to undesired epistemological, hermeneutical, and ethical implications, such as distorting claims, reinforcing existing biases, or omitting underrepresented cultures. Considering these risks and the absence of precise AI in archaeology policies, the European Cooperation in Science and Technology (COST) has called for shared frameworks for data principles and ethics (COST 054/24).

COST's efforts represent a significant change in cultural policy, as it is a bottom-up initiative, where researchers can create networks by publishing an open call and attracting

different stakeholders. As an EU-funded intergovernmental framework, COST's main objective is to develop pan-European research networks in all scientific disciplines (European Cooperation in Science and Technology [COST], n.d.).

They have published "Managing Artificial Intelligence in Archaeology" (MAIA), trying to fill the policy disconnect by capacity building and coordinating research and development. For example, they have suggested setting findability, accessibility, interoperability, and reusability (FAIR) as data principles to solve technical issues like noisy and inoperable data and to assign epistemological responsibility. This not only makes data accessible but also machine-readable, enabling AI tools to process and analyze it effectively while minimizing data. This could also be carried on to the digitization principles, as coherent and consistent digitization of tangible heritage could elevate some of the data issues regarding AI applications.

At the same time, this increased focus on digital tools and products raises new concerns. One of these considerations is the neglect of the physical heritage and a shift in priorities. It has been stressed that digital archaeological data management should not substitute for the management of actual archaeological sources. One of the reasons for this threat is the lack of awareness about the value of archaeological remains to society as a whole, which is why forging close connections with other domains such as education, economy, and environment is suggested as the solution. For example, embedding archaeology into school curricula from an early level and enhancing the synergies between culture and education are recommended for both maintaining public support for archaeology and improving the use of AI (European Archaeological Council, 2015; MONDIACULT-2022/CPD/6). This encourages the public to become contributors to knowledge production, demonstrating this as a shift to bottom-up policies to ensure the centrality of the field. This effort is reflected in the case of Pompeii, in particular the Casa del Centenario's virtual reconstruction, as the AI-enabled reconstruction is used as a tool to stimulate public engagement, participatory meaning-making, and transparency. Overall, linking archaeology to contemporary societal challenges, broader goals, and sharing it with diverse individuals is seen as a way to foster broader cultural relevance, and not lose archaeology's meaning to digital tools.

As digital transformation accelerates, stakeholder involvement is increasingly recognized in policy discourse as essential for developing responsible, adaptive, and culture-centered AI practices in archaeology. In this domain, the key stakeholders are archaeologists, information technologies and AI specialists, researchers, data managers, students, cultural

institutions, local communities, policy-makers, and funders. This is repeated in the policy documents for several reasons. Firstly, ethical considerations are an integral part of archaeology as well as AI, and when combined they cover representation and ownership; "human agency and oversight; technical robustness and safety; privacy and data governance; transparency; diversity, non-discrimination, and fairness; societal and environmental wellbeing, and accountability" (COST 054/24). Involving different stakeholders is the most effective way of guaranteeing transparency, inclusiveness, and knowledge exchange. Also, the availability of various stakeholders indicates making archaeology and AI are more explicable to non-experts. Every party involved has the right to comprehend the technicalities and the subtleties of these developments. Furthermore, this generates higher availability of long-term private-public and international partnerships and funds as it increases the number of available research partners. Funding instruments from different parties are essential to decentralize AI governance, make it more democratic and public-oriented (Pasikowska-Schnass & Lim, 2023; Caramiaux, 2020; COST 054/24). The institutional papers underscore the weight of multi-stakeholder frameworks to solve the AI in archaeology and heritage challenges that actors cannot solve by themselves.

In particular, archaeology-based documents place great value on best practices and knowledge sharing between stakeholders. This has evolved as a response to the scarcity of enforceable AI in archaeology policies, providing interim governance. To progress beyond the state-of-the-art, the limitations and the capacity of the field to multi-leveled and multidisciplinary implications stakeholders, especially archaeologists and AI specialists, need to share current practices. Picking the best practices promotes coherence, alignment, and collaboration across projects and institutions alongside adaptive governance. The test, share, and refine cycle of these practices encourages the development of interoperable ethics, techniques, procedures, and knowledge. Moreover, guiding experiences can direct smaller institutions with fewer resources or human capital, enabling a coherent and sustainable transformation in the field. Adopted practices could create normative standards and act as soft laws, creating a temporary bridge between policy and practice, influencing future sector and AI-specific cultural policies and funding schemes. Until policies catch up to the practices, in an indispensable field like archaeology, this could avoid the irreversible consequences of using AI without regulatory frameworks (COST 054/24).

Overall, the use of AI in archaeological contexts endures challenges such as inconsistent and limited data, vulnerability to bias, ethical frailty, material fragility, uncollaborative and uncoordinated innovation. Not only are there no sector-specific up-to-

date policies practices aren't classified as high-risk AI; regulation resorts to soft laws and prudence.

The mismatch between the pace of innovation and regulation is evident, also illustrated in Pompeii. There are three different AI projects for the same archaeological site, yet there is not one reference to a common framework in the published papers. This verifies that the cleanliness and objectivity of the inputs, the transparency of the AI processes, and the accuracy of the outcomes are entirely dependent on the associated scientist's judgments. Given these challenges and gaps in present AI and archaeology policies, the next theme will explore the new standards and topics that must be met by cultural policies.

5.5 Cultural Policy Elements

This last theme of the analysis functions serves as a unifier of the prior themes, as it establishes the current cultural policy challenges and the necessary future policy elements for improved AI governance in archaeology. These new elements are more than mere technical adaptations and symbolize a shift in what cultural policy must become in the digital and contemporary society. These new principles are more citizen-centered, participatory, and borderless, oriented towards creating an equal and profound AI transformation. The case of Pompeii also underscores these emerging trends, as the absence of formal cultural policy instruments has prompted a more ground-up approach to AI regulation in archaeology.

Cultural policy currently faces two major challenges: infrastructural inequality and ethical sensitivities. Infrastructural inequality refers to disparities in AI readiness across institutions and countries, as well as broader concerns about digital interdependence. Even before the rise of AI, the digital divide existed both within and between countries. Initially, the digital divide referred to the gap between people who had and did not have access to information and communication technologies (ICT), but it has since evolved into a more layered concept, now understood in terms of three levels. The first level is related to access to ICT through the availability of infrastructure. The second level is focused on the divide between digital skills and literacy and the third level revolves around the unequal outcomes in social, economic, and personal benefits from digital engagement (Lythreatis et al., 2022).

In the cultural heritage sector, this presents itself through differentiating between institutions with digital heritage strategies and infrastructures, both human capital and physical, from those without, above all affecting smaller institutions. This divide and its inequalities have been exacerbated with COVID-19, which widened the digital skills gap and accelerated digital transformation, possibly making AI the fourth level of the digital divide

(European Heritage Hub, 2024). Both the EU and UNESCO disclose this multi-leveled digital divide and state that it is essential to close these gaps. To do so, they suggest ambitious objectives to be reached by 2030 to equip and reskill cultural heritage professionals including on AI and data management, equally deploying infrastructure and equipment across Member States, and integrate both culture and digital skills into school curriculums (SHS/BIO/REC-AIETHICS/2021; Information and Notices 2021/7953; Report 2020/2017(INI); MONDIACULT-2022/CPD/6).

All these interventions reveal that addressing the digital divide is not solely a matter of individual capacity or institutional initiative, but a structural challenge that requires coordinated state-level action. The responsibility of national governments and supranational bodies in maintaining digital sovereignty is becoming progressively more important as cultural institutions throughout Europe and beyond increasingly depend on proprietary tools and private AI companies. Hence, to some extent, it is left to the state to take an enabling and equalizing role.

Especially in the EU, cultural heritage institutions are severely exposed to the interplay between state and private actors because they are mostly state-funded. While this somewhat reassures them, it also limits their chances to develop and invest in novel, expensive, and exploratory technologies like AI. To continue digitizing and innovating in heritage protection, this encourages cultural heritage institutions to rely on private funding, however, most agreements grant exclusive rights to the private partners, preceding market monopoly. In this case, the Member States are called to find additional funding for other private players to invest in AI in cultural industries, provide fair market conditions, take the power of data and digital technologies into account when overseeing mergers and competition policies, and provide funding mechanisms themselves.

This issue is particularly urgent in archaeology, where digital infrastructure is fragmented and data is often produced through short-term, unsustained research projects. As discussed earlier, most digital archaeological data is not reusable or accessible in the long term and is not machine-operable. The need for sustainable preservation efforts regarding AI requires either public funding or long-term private partnerships, yet in both cases, state-managed frameworks are essential to guarantee digital authority. The states and supranational bodies are urged to set these frameworks, ethical safeguards, auditing schemes, and harmonious rules to ensure transparency, traceability, data protection, fair and non-discriminative uses of AI in cultural heritage, regarding AI supply from private actors to not

lose cultural autonomy (Pasikowska-Schnass & Lim, 2023; Information and Notices 2021/7953; Report 2020/2017(INI); Report 2020/2017(INI); COST 054/24)

However, these regulations being set on the national level or global level, are not sufficient on their own. Cultural policy must expand to include those who are (most) affected and involved with the implementation of AI in archaeology or tangible heritage. This calls for a shift from top-down governance models toward participatory policymaking, where archaeologists, AI developers, cultural workers, and civil society are actively involved in shaping the tools and rules that guide digital transformation. On one hand, this would develop cultural policies based on actual applications in the field and tailor policies to the needs of the field, which would ensure policies' success and longevity. On the other hand, this would give voice to cultural heritage communities, minorities, different age groups, and genders, creating comprehensive strategies while ensuring the availability of the benefits to everyone. This inclusive approach is the principal way of harmonizing the domain and minimizing inherited ethical challenges. When the scope is narrowed to archaeology, a field without AI regulation, participatory practices alongside responsible stakeholders are the only ways to combat fragmentation. Especially expanding archaeology to academically less involved stakeholders will ensure the public's engagement by emphasizing responsiveness to their interests and fostering broader cultural relevance. Building an open communication basis for policies would allow the co-creation of broader archaeological value (e.g., societal, economic, environmental, educational) alongside democratizing state and corporate reach.

In the end, incorporating AI into archaeological heritage policies requires the balancing of different dynamics. While cultural policies must be democratic and inclusive, the existing landscape, shaped by unfair AI developers and financial inequities among institutions, requires state intervention to achieve the balance and unity required for a global transition. Both now and in the future, these policies must meet general demands, such as ethics, inclusion, and common values, as well as heritage-specific criteria and norms. The following chapter returns to the Archaeological Park of Pompeii to reflect on these dynamics in practice, before concluding this thesis.

5.6 From Pompeii to Policy

The World Heritage Site of Pompeii, located in Italy, is a globally significant archaeological site, known for its historic, economic, aesthetic, and societal values. Today, its reputation has expanded to an innovator as it hosts several different applications of AI in archaeology to showcase its potential in preservation, interpretation, and management.

Pompeii links the findings from the analysis to real-world applications, reflecting broader consequences.

To provide an answer to the research question, the manifestation of analyzed themes in Pompeii will be investigated. Starting with AI governance and ethics, there were stated ethical concerns regarding every project. Especially the rePAIR project, which uses machine learning and 3D computer vision to reassemble frescoes, highlights significant ethical issues. These are spread throughout the whole project cycle, ranging from the creation of the metadata to train the algorithm, to the potential of digital forgeries. Despite these concerns, there are no mentions of applied policies or frameworks to ensure ethical consistency and coherence. In the analyzed documents, the ethical concerns of AI in different sectors were thoroughly investigated, and possible ways to solve these threats were discussed, especially through FAIR standards and copyright. Yet, no enforceable regulations for AI applications in archaeological cultural heritage were revealed, resulting in an overreliance on expert oversight and judgment to address these potential risks.

The second theme, innovation in tangible heritage, which focuses on digitization and data governance, both for an end goal and for AI, presents different opportunities and risks. As discussed, every AI intervention primarily requires data digitization to both train AI and generate results. In a particularly big archaeological site like Pompeii, this results in massive volumes of digitized archeological data without a declared owner, which could be the archaeological park, the state, the EU funders, or the AI developers. Moreover, with the promotion of open-access data sets, this unclaimed data could be used out of context or manipulated. The lack of digital watermarks and data misuse was stated among the primary concerns of the rePAIR project as they are digitizing extensive amounts of frescoes to reassemble them with AI-assisted robotics. The industry documents recognize this dichotomy between open-access digitization and ownership rights; however, they are setting ambitious goals for the percentage of digitized heritage and freely accessible uniform data by 2030. Hence, this remains an unresolved area both for Pompeii and cultural policy.

Pompeii confirms policy papers' goal to establish archaeology's centrality for different purposes and expand the ways to involve the public. In particular, the virtual reconstruction of Casa del Centenario established transparency and co-creation as the cornerstones of the project and offered a new way to deliver heightened educational and experiential value. This project reaffirms that AI tools if properly managed, can elevate an archaeological site's worth by making it more multifaceted and beneficial for the visitors.

Lastly, the fourth theme revealed a desired shift towards bottom-up, participatory, and inclusive policies balanced by top-down interventions to create fair market conditions and possibilities for every participant. In archaeology, bottom-up policies are necessary for experts to fill the lack of established and shared guidelines. In the case of AI projects in Pompeii, the bottom-up approach comes from the collaboration between heritage experts and AI developers who are completely in charge of the ethicality and neutrality of these integrations. Yet, this introduces a new aspect of subjectivity because every expert's judgment is unique and is not generalizable as it comes from their personal beliefs. However, they are also the ones who can examine the archaeological data and AI algorithms the best, as they have the most knowledge and experience, which results in an intricate balance in which experts have to adhere to the standards that are created by themselves. Therefore, the absence of binding ethical and implementation guidelines makes the projects over-reliant on expert discretion, which furthers the need for sector-specific, horizontal schemes that originate from the combination of bottom-up participation and top-down regulation.

Altogether, this case mirrors the discovered absence of cultural policies targeting archaeology and AI, as there are no references to any interoperability standards between practices. This hinders the goals of a global digital transformation of the (archaeological) heritage field since there is no guaranteed coherence even on the local, site-specific level. In Pompeii's papers, the main concerns regarding cultural policy are revealed to be ambiguity around ethical audit tools/criteria, metadata frameworks, copyright protection, and interoperability standards. This leaves Pompeii isolated and contributes to the fragmentation between archaeological data and cultural institutions, as it makes it hard to replicate these achievements and protect the site.

On the contrary, the lack of restrictive governance mechanisms could introduce flexibility to these applications and promote their fast integration; however, in the long run, it can produce issues jeopardizing the integrity of the archaeological sites and AI mechanisms, creating black boxes regarding these applications.

The current policy landscape discloses these gaps and states them as areas to be developed with the collaboration between policymakers and different stakeholders, like archaeologists, computer scientists, and the public. Besides the current challenges, policy documents reveal that AI should be introduced to archaeological sites when it is believed that it will serve a purpose, like increased preservation, site management, and delivery to the audience. Pompeii exemplifies this encouragement by repeatedly highlighting benefits such as public awareness, pristine reconstruction, improved site observation, and more.

In conclusion, Pompeii represents both the successes and shortcomings of cultural policies and industry documents that were revealed in the qualitative document analysis. While its AI projects showcase the potential of AI in archaeology in public engagement, site management, and conservation activities, they also reveal missing specialized frameworks to supervise ethics, accountability, transparency, and data. It confirms the need for specific cultural policies targeting AI applications in archaeology to create a sustainable digital transformation in the field, to highlight archaeology's values and uniqueness instead of making it a tool of cultural and historical manipulation.

6. Conclusion

This thesis investigated policy and industry papers regarding AI and archaeological heritage to assess the current policy governance of this emerging phenomenon and provide future direction for it. The findings revealed it to be a novel field in cultural policy, as instead of sector-specific and enforceable regulations, there were broader acknowledgments of AI in archaeological heritage under the title of tangible cultural heritage and innovation.

The main policy gap stems from the lack of coherent and united frameworks, which is reaffirmed in the mini case study of Pompeii. Pompeii shows successful applications of AI in archaeology, providing enhanced decision-making and monitoring tools, unraveling puzzles in heritage, and encouraging the involvement and interpretation of the public for more personal connections with the sites. These are unmatched developments in the field of archaeology as they combine the traditional way with state-of-the-art technologies, expanding the possibilities of the field. However, there are no references to any Pompeii-specific or global oversight mechanisms to ensure ethical, fair, and valid use of AI processes' inputs, processes, and outputs. Moreover, the absence of policies and frameworks is currently fostering a collaborative environment where best practices are shared and the changes are being managed ad hoc by experts. As AI is a constantly progressing field that improves archaeological site management and conservation practices, policymakers' priority should be to reach the current state of these applications without hindering their further development.

The research revealed that cultural policy addresses multiple contrasting forces and dynamics. While encouraging open access to data, it also has to guarantee its protection with copyright, or while promoting a global digital transformation of (archaeological) heritage, it has to work towards closing the digital literacy and infrastructure gaps. The extent of these dilemmas makes the field of archaeological heritage and AI broader than how niche it may seem. Beyond the primary stakeholders of policymakers, computer scientists, cultural

institutions, and archaeologists, the documents called for the involvement of the public, educators, students, and AI suppliers to reaffirm archaeology's centrality while promoting AI. This indicates that the future policy discourse has to be more inclusive and participatory to ensure sustainable and fair governance of the domain as well as its spillover effects.

However, the field's novelty still requires top-down policies to create equal standards for innovation, both in the tech and heritage sectors. A right balance between top-down and bottom-up policies is essential to ensure the democratization of access to heritage and uniform transformation for every stakeholder in the field. This also reaffirms the important role of cultural policies, since reliance on best practice sharing and experts' oversight does not suffice to coherently control and transform this field.

In conclusion, this analysis reveals that even though there is a call for cultural policies regarding AI in archaeology, the current policy landscape doesn't offer solutions to the needs that were discussed in the theoretical framework, such as avoidance of bias, protection of intrinsic value, and authenticity. This call involves sector-specific policies for two sides: developers and users. On the one hand, through these policies, developers must have strict legislations to create unbiased datasets, freely share and access them, and protect the originality and source of these datasets. On the other hand, users must resort to frameworks to guarantee the ethical, meaningful, transparent, and valid use of AI in archaeology. To develop these comprehensive policies with equal starting ground for all institutions across the globe, policymakers should collaborate with both experts and non-experts to create balanced and effective policies.

Nevertheless, there are many directions for future research. A prominent question is, even if AI gets the utmost training, could it ever manage or interpret data (e.g., scripts, ruins, objects) that are inherently human while respecting all its cultural, historical, and emotional sensitivities? The dualities aforementioned and discussed in the thesis are all potential areas of analysis, which makes this a highly relevant and promising research topic.

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Appendix

Appendix A1 - Complete Coding Table Utilized in Atlas.ti

Main Theme	Codes
AI Governance & Ethics	AI Governance
	AI Risk Prioritization
	Bias and Discrimination
	Copyright and IT Laws
	Environmental Impact
	Ethical AI
	Ethical Assessment Tools & Criteria
	General-Purpose AI
	Human-Centric AI
	Ownership and Control in AI Systems
	Transparency and Accountability
	Trustworthy AI
	Value-based AI

Tangible Heritage Preservation & Innovation	Access to Culture
	AI for Heritage Risk Prevention
	AI in Tangible Heritage
	Cultural Management
	Data Space for Cultural Heritage
	Heritage Digitization
Archaeological Heritage Focus	AI Applications
	AI Archaeology Challenges
	AI for Archaeological Site Management
	Archaeological Heritage Protection
	Archaeologists' Oversight
	Archaeology in Education and Awareness
	Artifact Focus
	Best Practices and Knowledge Sharing
	Centrality of Archaeology
	Collaborative and Participatory Archaeology
	Public Engagement in Archaeology
Cultural Policy Elements	Citizen-Centered
	Coherence
	Current Policy Challenges
	Digital Divide
	Digital Literacy
	Future Policy Governance
	Globality
	Open Data Policy
	Stakeholder Involvement
	Utilizing Digital Tools
	Value of Tangible Heritage