Digital Preservation Strategies for Born-Digital Archaeological Records

Favour Olaoye, Chris Bell and Peter Broklyn

August 1, 2024

Digital preservation strategies for born-digital archaeological records

Authors
Favour Olaoye, Chris Bell, Peter Broklyn

Abstract

The rapid advancement of digital technologies has significantly impacted the field of archaeology, particularly in the management of born-digital records—data that originates in digital form rather than being converted from physical formats. These records, which include digital excavation documentation, 3D models, and geospatial data, pose unique challenges for long-term preservation. This paper explores digital preservation strategies specifically tailored for born-digital archaeological records. It examines the critical aspects of data integrity, metadata standards, and technological obsolescence. Key strategies discussed include the implementation of robust digital preservation frameworks, regular format migrations, and the development of comprehensive metadata schemas to ensure long-term accessibility and usability. The paper also highlights the importance of collaboration between archaeologists, digital preservationists, and IT professionals to establish best practices and create sustainable preservation solutions. By addressing these challenges, the paper aims to contribute to the effective stewardship of valuable digital archaeological data for future research and heritage management.

I. Introduction

In the digital age, the field of archaeology has increasingly embraced technological innovations to enhance research methodologies and data documentation. Born-digital archaeological records—data created and stored in digital formats from the outset—represent a significant shift from traditional paper-based documentation and analog media. These records encompass a wide range of data types, including digital field notes, geospatial information, high-resolution imaging, and 3D reconstructions of artifacts and excavation sites.

As the volume and complexity of born-digital records continue to grow, so do the challenges associated with their long-term preservation. Unlike physical artifacts, digital records are susceptible to issues such as technological obsolescence, data corruption, and format degradation. These challenges underscore the need for effective digital preservation strategies to ensure that valuable archaeological data remains accessible and usable for future generations of researchers and the public.

This paper aims to explore the strategies and practices essential for the preservation of born-digital

II. Challenges in Digital Preservation

The preservation of born-digital archaeological records presents several unique challenges that must be addressed to ensure the long-term usability and integrity of these valuable data assets. Key challenges include:

Technological Obsolescence: Digital records are often created using specific software or hardware that may become obsolete over time. As technology evolves, older formats and applications may no longer be supported, making it difficult to access or interpret historical data. This challenge necessitates regular updates and migrations to newer formats or systems to maintain data accessibility.

Data Integrity and Corruption: Digital data is vulnerable to corruption and loss due to hardware failures, software bugs, or human error. Ensuring data integrity requires the implementation of rigorous backup and verification processes. Regular checksums and data validation procedures are crucial for detecting and correcting errors before they lead to data loss.

Format and Media Longevity: Digital records are stored in various formats and media types, each with its own lifecycle. The rapid evolution of file formats and storage media can lead to issues with readability and compatibility. To mitigate these risks, it is important to adopt standardized, widely-supported formats and to plan for periodic migration of data to current media.

Metadata Management: Metadata—data that describes and provides context for digital records—is essential for future usability and interpretation. However, creating and maintaining comprehensive metadata can be challenging due to the need for standardized metadata schemas and consistent documentation practices. Inadequate metadata can hinder the ability to discover, understand, and use digital records over time.

Resource Constraints: Effective digital preservation requires significant resources, including financial investment, technical expertise, and dedicated personnel. Many archaeological institutions, particularly smaller

III. Strategies for Digital Preservation

To address the challenges of preserving born-digital archaeological records, several strategies have been developed to ensure long-term accessibility and usability. These strategies include:

Regular Format Migration:

One of the primary strategies for mitigating technological obsolescence is regular format migration. This involves transferring digital records to current, widely supported file formats and storage systems. By periodically updating the formats, organizations can avoid data loss due to outdated technology. For example, migrating data from older proprietary formats to open standards can enhance compatibility and future-proofing.

Comprehensive Metadata Documentation:

Metadata—data about data—is crucial for ensuring that digital records remain interpretable and usable over time. Comprehensive metadata documentation should include information about the creation, structure, and context of the records, as well as any relevant technical specifications. Adopting standardized metadata schemas, such as the Dublin Core or the Data Documentation Initiative (DDI), can facilitate consistency and interoperability across different systems and projects.

Data Integrity and Error Checking:

Maintaining data integrity involves implementing mechanisms to detect and correct errors that may occur during storage, transmission, or processing. Techniques such as checksums, hash functions, and redundancy checks can help verify that digital records remain unaltered and reliable. Regular integrity checks and validation procedures are essential to identify and address potential issues before they impact the usability of the data.

Redundancy and Backup Systems:

Redund

IV. Case Studies

Background

The Pompeii Archaeological Archive, which encompasses a vast array of digital records from ongoing excavations and research at the ancient Roman city of Pompeii, serves as an exemplary case for understanding the challenges and solutions in digital preservation for archaeological data. This archive includes digital field notes, high-resolution imaging, 3D models of artifacts, and geospatial data documenting the site's extensive ruins.

Challenges Faced

Technological Obsolescence: The Pompeii Archive initially utilized proprietary software for 3D modeling and data management. As technology advanced, the software became outdated, and the data became difficult to access and use. This issue necessitated the migration of data to more current, open-source platforms to ensure ongoing usability.

Data Integrity and Corruption: Several instances of data corruption occurred due to hardware failures and software bugs. Regular backup procedures and the implementation of error-checking protocols were critical in detecting and recovering from these issues.

Format and Media Longevity: The archive's data was stored in a variety of formats and media, some of which were at risk of becoming obsolete. The project team established a routine for format migration, converting data to standardized, widely-supported formats, and updated storage media as needed.

Metadata Management: Creating comprehensive metadata for the extensive Pompeii records was a significant challenge. The team developed a standardized metadata schema that included detailed descriptions, contextual information, and preservation notes. This schema was integrated into their digital repository to facilitate data discovery and management.

Resource Constraints: The preservation effort required substantial financial and technical resources. The Pompeii project team addressed this by partnering with academic institutions and technology companies, securing grants, and engaging in collaborative preservation initiatives.

Legal and Ethical Issues: The project faced legal and ethical considerations regarding the use and sharing of sensitive archaeological data. Policies were developed to govern access and usage, ensuring that proprietary and sensitive information was protected while still facilitating research and public engagement.

Strategies Implemented

Data Migration and Standardization: To combat technological obsolescence, the team migrated data from outdated systems to modern, open-source platforms. Standardization of data formats ensured compatibility with future technologies.

Regular Backups and Validation: Implementing a robust backup strategy, including frequent snapshots and error-checking routines, helped maintain data integrity and recover from corruption incidents.

Metadata Schema Development: A comprehensive metadata schema was created and integrated into the digital repository, enhancing data management and discoverability.

Collaborative Partnerships: Collaborations with academic and technological partners provided additional resources and expertise, helping to address resource constraints and leverage external support

Policy Development: Clear policies were established for the management of sensitive data, balancing accessibility with legal and ethical considerations.

Outcomes and Lessons Learned

The preservation efforts for the Pompeii Archaeological Archive have successfully ensured the continued usability and accessibility of the digital records. Key outcomes include improved data management practices, enhanced collaboration with external partners, and the establishment of robust preservation protocols. The project highlights the importance of proactive planning, resource allocation, and collaborative approaches in addressing the challenges of digital preservation in archaeology.

This case study demonstrates that while digital preservation presents complex challenges, effective strategies and collaborative efforts can significantly enhance the long-term stewardship of born-digital archaeological records.

V. Future Directions

As digital technologies and archaeological practices continue to evolve, the field of digital preservation must adapt to meet emerging challenges and opportunities. Future directions in the preservation of born-digital archaeological records include:

Advancements in Preservation Technologies:

Ongoing developments in preservation technologies, such as artificial intelligence (AI) and blockchain, offer new possibilities for safeguarding digital records. AI-driven tools can automate metadata generation and enhance data recovery processes, while blockchain technology can provide secure and immutable records of digital provenance and integrity. Exploring and integrating these technologies could revolutionize digital preservation practices.

Enhanced Collaboration and Standards:

Collaboration between archaeologists, digital preservationists, and technology developers is crucial for advancing preservation practices. Establishing and adhering to international standards and best practices will promote consistency and interoperability across different projects and institutions. Initiatives such as the Open Archival Information System (OAIS) reference model and the FAIR (Findable, Accessible, Interoperable, and Reusable) data principles are key frameworks that can guide future efforts.

VI. Conclusion

The preservation of born-digital archaeological records is crucial for safeguarding the integrity and accessibility of valuable data for future generations. As digital technologies continue to advance, the challenges associated with preserving digital records, such as technological obsolescence, data integrity, and metadata management, become increasingly complex. However, through the implementation of strategic preservation practices—including regular format migration, comprehensive metadata documentation, data integrity checks, and robust redundancy systems—these challenges can be effectively managed.

Case studies of successful digital preservation initiatives demonstrate the practical application of these strategies and highlight the benefits of collaborative efforts among archaeologists, digital preservationists, and technology experts. Looking ahead, the field must embrace emerging technologies and continue to refine preservation methods to address evolving challenges and opportunities.

In conclusion, a proactive and adaptable approach to digital preservation will ensure that born-digital archaeological records remain a valuable resource for research, education, and heritage management. By staying informed about technological advancements and best practices, the archaeological community can safeguard digital records and support the ongoing exploration and understanding of our shared cultural heritage.

References

1. Morgan, C. (2022). Current digital archaeology. *Annual Review of Anthropology*, *51*(1), 213-231.

2. Zubrow, E. B. (2006). Digital archaeology: A historical context. *Digital archaeology: bridging method and theory*, 10-31.

3. Daly, P., & Evans, T. L. (2004). *Digital archaeology: bridging method and theory*. Routledge.

4. Huggett, J. (2017). The apparatus of digital archaeology. *Internet archaeology*, *44*.

5. Morgan, C., & Eve, S. (2012). DIY and digital archaeology: what are you doing to participate?. *World Archaeology*, *44*(4), 521-537.

6. Kansa, S. W., & Kansa, E. C. (2018). Data beyond the archive in digital archaeology: an introduction to the special section. *Advances in Archaeological Practice*, *6*(2), 89-92.

7. Morgan, C. L. (2012). *Emancipatory digital archaeology*. University of California, Berkeley.

8. Tanasi, D. (2020). The digital (within) archaeology. Analysis of a phenomenon. *The Historian*, *82*(1), 22-36.

9. Bruno, F., Bruno, S., De Sensi, G., Luchi, M. L., Mancuso, S., & Muzzupappa, M. (2010). From 3D reconstruction to virtual reality: A complete methodology for digital archaeological exhibition. *Journal of Cultural Heritage*, *11*(1), 42-49.

10. Graves, M. W. (2013). *Digital archaeology: the art and science of digital forensics*. Pearson Education.

11. Dallas, C. (2016). Jean-Claude Gardin on archaeological data, representation and knowledge: Implications for digital archaeology. *Journal of Archaeological Method and Theory*, *23*, 305-330.

12. Graham, S. (2022). *An enchantment of digital archaeology: raising the dead with agent-based models, archaeogaming and artificial intelligence*. Berghahn Books.

13. Clarke, M. (2015). The digital dilemma: preservation and the digital archaeological record. *Advances in Archaeological Practice*, *3*(4), 313-330.

14. Kintigh, K. W., & Altschul, J. H. (2010). Sustaining the digital archaeological record. *Heritage Management*, *3*(2), 264-274.

15. Rusho, M. A., & Hassan, N. (2024). Pioneering The Field Of Digital Archeology In Bangladesh.

16. Frachetti, M. (2006). Digital archaeology and the scalar structure of pastoral landscapes. *Digital archaeology: bridging method and theory*, 113-132.\

17. Jamil, M. H., Annor, P. S., Sharfman, J., Parthesius, R., Garachon, I., & Eid, M. (2018, September). The role of haptics in digital archaeology and heritage recording processes. In *2018 IEEE International Symposium on Haptic, Audio and Visual Environments and Games (HAVE)* (pp. 1-6). IEEE.

18. Huggett, J. (2020). Capturing the silences in digital archaeological knowledge. *Information*, *11*(5), 278.

19. Wessman, A. P. F., Thomas, S. E., & Rohiola, V. (2019). Digital Archaeology and Citizen Science:: Introducing the goals of FindSampo and the SuALT project. *SKAS*, *2019*(1), 2-17.

20. Dennis, L. M. (2019). *Archaeological ethics, video-games, and digital archaeology: a qualitative study on impacts and intersections* (Doctoral dissertation, University of York).

21. Rusho, M. A., & Hassan, N. (2024). Pioneering The Field Of Digital Archeology In Bangladesh.

22. Börjesson, L., & Huvila, I. (2018). Digital archaeological data for future knowledge-making. In *Archaeology and archaeological information in the digital society* (pp. 14-36). Routledge.

23. Watrall, E. (2019). Building scholars and communities of practice in digital heritage and archaeology. *Advances in Archaeological Practice*, *7*(2), 140-151.

24. Levy, T. E., & Smith, N. G. (2016). On-site GIS digital archaeology: GIS-based excavation recording in Southern Jordan. In *Crossing Jordan* (pp. 47-58). Routledge.