POLICY WHITE PAPER

MaDiH (مديح): Mapping Digital Cultural Heritage in Jordan.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

This white paper reports on the findings of the *MaDiH (مديح): Mapping Digital Cultural Heritage in Jordan* project.[1] It is complemented by a technical white paper. MaDiH (مديح) is a collaborative project between King's Digital Lab (KDL) at King's College London, the Hashemite University, the Council for British Research in the Levant (CBRL), the Department of Antiquities of Jordan (DoA), the Jordan Open Source Association (JOSA), and the Endangered Archaeology in the Middle East and North Africa (EAMENA) project. The project ran for two years, from February 2019 - April 2021.

The goal of the project was to contribute to the long-term sustainable development of Jordan's digital cultural heritage by identifying key systems, datasets, standards, and policies, and aligning them to government digital infrastructure capabilities and strategies. This policy white paper focuses on alignment to national and international policies and standards and makes recommendations for future action. The technical white paper provides more detailed technical descriptions of standards, datasets, data repositories and other assets, and defines requirements for future activity. Each section of the white papers lists associated challenges and opportunities, which are summarised in appendices. Taken together, the intention is for the white papers to define the current state of digital cultural heritage (DCH) in Jordan, inform and align to Jordanian government policy, and inform planning and technical design processes that can enable the future development of Jordanian DCH.

MaDiH's (مديح) policy goals aimed to ensure any technical work or analysis undertaken in the project were aligned to government policies and international best practices in cultural heritage management, digital cultural heritage, and research software engineering. Practical prototyping was used to ensure analysis and lessons learned are cost-effective and aligned to real-world scenarios, and a series of workshops with stakeholders from the cultural heritage, research, government, and technology sectors built a sense of community, facilitated knowledge exchange, and ensured the project fulfilled the needs of the local community. A hackathon, led by the Jordan Open Source

[1] "Newton-Khalidi Cultural Heritage and Sustainable Development in Jordan", AHRC, accessed January 20, 2021, https://ahrc.ukri.org/funding/apply-for-funding/archived-opportunities/cultural-heritage-and-sustainable-development-in-jordan/.

Association, ensured analysis and lessons learned were aligned to educational and commercial opportunities.

To ensure alignment between its policy and technical goals and to provide real-world evidence of its findings, MaDiH (مديح) produced a range of digital outputs including a publicly available prototype data catalogue,[2] a website[3] to communicate project activity, and Twitter[4] and Facebook[5] accounts for public communication. Although intended as short-term research assets, used to build a sense of community and inform the production of the white papers, efforts have been made to sustain those assets for future use. The MaDiH (مديح) CKAN catalogue is of particular importance, as it fills an urgent need for a holistic view of cultural heritage datasets held across and outside Jordan. It also aggregates metadata and content that could provide the basis for future system design, data aggregation and integration (including the ability to cross-search existing databases), and product development.

Key policy findings of the MaDiH (مديح): Mapping Digital Cultural Heritage in Jordan project:[6]

- Jordan is well positioned to augment its national digital strategy with digital cultural heritage.
- Jordan has a strong culture of open access content and open source software that is highly beneficial to the future of Jordanian DCH.
- The Jordanian technology sector is highly capable and could amplify investment in DCH through research and development (R&D), product development, and enabling business and tourism aims.
- There is a genuine willingness amongst Jordanian heritage officials to support and be part of international archaeological/ heritage research.

[2] "MaDiH CKAN repository", the MaDiH team, 2019, accessed April 19, 2021, https://madih-data.kdl.kcl.ac.uk/.
[3] "MaDiH website", the MaDiH team, 2019, accessed April 19, 2021, http://madih-jordan.org/.
[4] The MaDiH team (@madih_info), 2019, accessed April 19, 2021, https://twitter.com/madih_info.
[5] The MaDiH team, 2019, Mapping Digital Cultural Heritage in Jordan, MADIH, accessed April 19, 2021, https://www.facebook.com/MaDiHJO/.
[6] See Appendix C for more detailed findings and recommendations.

Key policy recommendations of the MaDiH (مديح): Mapping Digital Cultural Heritage in Jordan project:[7]

- Adopt a long-term view, designed for iterative development over 10-15 years.
- Work should be undertaken to scope, cost, and fund, the development of a National Centre for Digital Cultural Heritage in Jordan.
- National digital strategy should be updated to require the use of common international DCH technical standards.
- Training should be provided in research software engineering (RSE) for cultural heritage, in partnership with the education and technology sectors.
- Jordanian and UK stakeholders should recognise the necessity and effectiveness of developing DCH partnerships in Jordan.
- Efforts should be made to expand the audience for future similar projects, building on the momentum created by MaDiH (مديح).
- Content identified by MaDiH (مديح) should be used to disseminate information about Jordanian DCH projects, increase awareness of DCH career paths, and improve understanding of cultural and intellectual property rights.
- A prioritisation mechanism to digitise offline archives managed by institutions or individuals should be developed.

The Treasury, Petra
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[7] See Appendix C for more detailed findings and recommendations.

INTERNATIONAL POLICY CONTEXT

Cultural heritage

Cultural heritage is and has been defined in multiple ways, with the definition becoming increasingly inclusive over the years to include tangible, both immovable and movable, and intangible cultural heritage.[8] The UNESCO Hague Convention (1954) defined 'cultural property' as, among other things: *"Movable or immovable property of great importance to the cultural heritage of every people..."*[9] The 1972 UNESCO World Heritage Convention, and its associated recommendations and guidelines, focused on tangible immovable heritage.[10] While the main text focused on "monuments", "groups of buildings" and "sites", the guidelines also include historic areas and cultural landscapes, which are further discussed in other international policy documents.[11] In 2000, underwater cultural heritage was also included in the suite of UNESCO Conventions.[12] Movable items are also clearly part of UNESCO's 'cultural property' definition.[13] Finally, intangible cultural heritage was added in the 2000s.[14] It is worth noting that UNESCO's definition of 'heritage' includes natural as well as cultural

[8] An overview of definitions can be found in J. Jokilehto, *Definition of cultural heritage: References to documents in history* (ICCROM Working Group 'Heritage and Society' report, 2005).
[9] UNESCO, *Convention for the Protection of Cultural Property in the Event of Armed Conflict* (UNESCO, 1954). In addition, it mentions "buildings whose main and effective purpose is to preserve or exhibit the movable cultural property…" and "centres containing a large amount of cultural property…".
[10] UNESCO, *Convention concerning the protection of the World Cultural and National Heritage* (UNESCO, 1972); UNESCO, *WHC Operational Guidelines for the Implementation of the World Heritage Convention* (UNESCO, 1972); UNESCO, *Recommendation concerning protection, at national level, of the cultural and natural heritage* (UNESCO,1972).
[11] For example, the UNESCO, *Recommendation concerning the safeguarding and contemporary role of historic areas* (UNESCO, 1976); the ICOMOS, *Charter on Historic Gardens* (ICOMOS,1982); 1995 Council of Europe Recommendation No. R (95(9) of the Committee of Ministers to Member States on the Integrated Conservation of Cultural Landscape Areas as Part of Landscape Policies.
[12] UNESCO, *Convention on the Protection of Underwater Cultural Heritag*e (UNESCO, 2000); underwater sites and items were already part of earlier recommendations such as the UNESCO, *Recommendation concerning the protection of movable cultural property,* (UNESCO,1978).
[13] For example, UNESCO, *Convention for the Protection of Cultural Property in the Event of Armed Conflict* (UNESCO, 1954); UNESCO, *Recommendation on the means of prohibiting and preventing the illicit export, import and transfer of ownership of cultural property* (UNESCO, 1964) ; UNESCO, *Recommendation concerning the protection of movable cultural property,* (UNESCO, 1978).
[14] UNESCO, Universal Declaration on Cultural Diversity (UNESCO, 2001); UNESCO, *Convention for the Safeguarding of the Intangible Cultural Heritage (*UNESCO, 2003).

heritage, but it was beyond the scope of (this phase of) the project to include non-cultural heritage.[15] With the natural environment being an essential part of human perception (and use) of the landscape,[16] a case can be made to include this in future.

On a different level, cultural heritage is either perceived as *all* the remains from the past that have survived (studied through archaeology), or as the remains and customs *deemed important* by current society ("heritage").[17] UNESCO conventions and recommendations tend to lean towards the latter, specifying "special value" or "archaeological, historical, artistic, scientific or technical value and interest". This can, and has been, interpreted in different ways and definitions of cultural heritage, and therefore if and how it is protected, differ between countries[18] (the approach taken in Jordan is discussed below). In general, cultural heritage is deemed highly significant, and access to it is considered one of our basic human rights.[19]

Policy

From the 1950s onwards, international organisations such as, and especially, UNESCO and ICOMOS[20], have developed principles and guidelines for cultural (and natural) heritage policy. These result in documents - Conventions, Charters, Recommendations or Resolutions, with varying degrees of accountability - which states/countries (or in

[15] When natural heritage was present as part of a cultural heritage dataset this was recorded, but no attempt was made to record natural heritage-only datasets, nor was the database designed to capture these types of datasets. As mentioned in the text, datasets on *cultural* landscapes were included.
[16] European Science Foundation. *Landscape in a changing world: Bridging divides, integrating disciplines, serving society* (Science Policy Briefing, 2010) 41: 1-16.
[17] W.J.H. Willems, "The future of world heritage and the emergence of transnational heritage regimes", *Heritage & Society* 7(2) (2014): 105-120.
[18] Yahaya Ahmad, "The scope and definitions of heritage: from tangible to intangible". *International Journal of Heritage Studies* 12(3) (2006): 292-300.
[19] UN General Assembly, "Universal declaration of human rights." *UN General Assembly* 302, no. 2 (1948); UN General Assembly, "International Covenant on Economic, Social and Cultural Rights (1966)." *United Nations, Treaty Series* 993, no. 3. ; see also http://www.unesco.org/culture/culture-sector-knowledge-management-tools/10_Info%20Sheet_Right%20to%20Culture.pdf
[20] International Council on Sites and Monuments, especially its ICAHM or the International Committee on Archaeological Heritage Management which is concerned with developing global standards.

UNESCO terminology 'State Parties') can then ratify. When signing, the state party agrees to develop and implement measures as set out in the documents, i.e., a national heritage management policy.[21]

A considerable number of such documents currently exists[22] and have been ratified by an increasing number of countries. Notable examples are the UNESCO 1954 The Hague Convention, the ICOMOS 1964 Venice Charter,[23] and the UNESCO 1972 Convention concerning the protection of the World Cultural and National Heritage and related guidelines and recommendations, but there are many others at international level. At regional level, for example the 1992 'Malta Convention' by the Council of Europe with its 'the developer pays' principle was instrumental for heritage protection in the EU.[24] However, the execution of the principles relies mostly on national implementation and many separate national cultural heritage legislation and policies have been developed. In addition, even though signing a Convention is legally binding (in contrast to signing a recommendation or declaration),[25] there are few mechanisms for international checking, let alone enforcement, of ratified conventions.

The identification and compilation of inventories of heritage are part of key conventions, such as the 1968 Recommendation and the 1972 and 2003 UNESCO Conventions. Furthermore, it is stated in the 1972 Convention that the *"...appropriate … technical … measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage"* should be taken (with similar wordings in the 1968 Recommendation and the 2003 Convention).

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[21] W.J.H. Willems, "The future of world heritage and the emergence of transnational heritage regimes"*, Heritage & Society* 7(2) (2014): 105-120.
[22] A list updated until 2015 can be found at http://www.getty.edu/conservation/publications_resources/research_resources/charters.html
[23] ICOMOS, *The Venice Charter: International Charter for the Conservation and Restoration of Monuments and Sites* (ICOMOS, 1964) https://www.icomos.org/charters/venice_e.pdf (English) or www.international.icomos.org/venicecharter2004/arabic.pdf (Arabic).
[24] Council of Europe, *European Convention on the Protection of the Archaeological Heritage* (Council of Europe, 1969) https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/143.
[25] Standard-Setting Instruments of UNESCO, UNESCO, accessed January 20, 2021, http://portal.unesco.org/en/ev.php-URL_ID=12024&URL_DO=DO_TOPIC&URL_SECTION=201.html.

Therefore, while 'digital' is not specifically named, digital repositories can be considered indirectly as part of international heritage policy.[26] This perspective is buttressed by the UNESCO Charter on the Preservation of the Digital Heritage, which positions digital heritage as a "common heritage" worthy of protection.[27]

CHALLENGES	• International policies need to be implemented on a national scale. • No international mechanism exist for checking if ratified conventions are implemented. • On a national scale, it can be hard to enforce regulations, for example due to limited resources. • There is no single definition of 'cultural heritage'.
RECOMMENDATIONS	• Increase Jordanian alignment to international DCH policies and standards. • Use the broad definition of 'cultural heritage' to ensure Jordan's DCH is protected. • Consider including natural heritage in the project in future and/or increasing integration of digital documentation and protection of cultural and natural heritage through collaboration with natural heritage-focused partners.

DIGITAL CULTURAL HERITAGE & DIGITAL ARCHAEOLOGY

The Hashemite Kingdom of Jordan is located at a distinguishable geographical location at the heart of the Middle East. Jordan has relatively high levels of political stability and security which allows its government to focus on improving the lives of its citizens and encourage international tourism. Successive governments have prioritised investment in the information communication technology sector, turning the country into a regional digital technology hub. Jordan's internet infrastructure is of high quality in comparison to other countries in the Middle East (and some countries outside the Middle East with

[26] See for example James Smithies, Paul Millar, and Christopher Thomson, "Open Principles, Open Data: The Design Principles and Architecture of the UC CEISMIC Canterbury Earthquakes Digital Archive", *Journal of the Japanese Association for Digital Humanities* 1, no. 1 (2015): 10–36.
[27] UNESCO, *Charter on the Preservation of the Digital Heritage* (UNESCO, 2009), https://unesdoc.unesco.org/ark:/48223/pf0000179529.page=2.

significantly more economic resources). Internet services are provided by the three largest telecommunication companies in Jordan: Zain, Orange, and Umniah. Each company offers a range of data services, with excellent 4G mobile coverage in Greater Amman and along major roads as well as affordable rates. As a web-based project, providing information related to cultural heritage sites found across Jordan, MaDiH (مديح) benefits significantly from this infrastructure, and is designed to leverage it for national benefit. In many ways, the project demonstrates the value of investment in internet infrastructure in countries like Jordan, enabling access to cultural heritage information across the country.[28]

Jordanian digital cultural heritage (DCH) is characterised by a strong focus on digital archaeology (DA), because of the importance of archaeological sites to its economy and identity (see below), and because of its research history. Internationally, digital archaeology sits within the social sciences with strong connections to science and engineering.[29] It also has strong connections to the humanities. It has particularly strong affinities with computer science, and a history of collaboration reaching back to the 1950s. Although strongly influenced by library and archival science, DA has a more practical focus that seeks to generate data for archaeological analysis, store the results of archaeological digs, record site information in text and image form, and map contemporary and historic geographies and geographic and built features. Other use cases extend to historical gazetteers, prosopographia, and epigraphic databases. This has resulted in the use of a wide range of technologies, including extensive use of Geographic Information Systems (GIS) and Light Detection and Ranging (LIDAR) for mapping landscapes and the built environment, digital photography for terrestrial and aerial surveys, photogrammetry for reproduction of material artefacts, image scanning for document preservation and analysis, and Virtual Reality (VR) tools to recreate objects, buildings, and urban environments. The potential for digital twins to aid in cultural heritage management is also being explored along with other emerging

[28] Although 3- and 4G are currently still restricted to urban areas, especially in the north (Amman, Irbid, Zarqa) where the large majority of the population lives, and on and near major roads.
[29] For recent general descriptions of digital archaeology see Parker VanValkenburgh and J. Andrew Dufton, "Big Archaeology: Horizons and Blindspots", *Journal of Field Archaeology* 45, no. sup1 (20 February 2020): S1–7; Davide Tanasi, "The Digital (within) Archaeology. Analysis of a Phenomenon", *The Historian* 82, no. 1 (2 January 2020): 22–36.

technologies such as drones, commonly used in archaeology for use cases such as aerial photography and to access otherwise inaccessible sites. The need to analyse the sometimes significant amounts of data that results from DA projects has led to widespread use of traditional statistical analysis, alongside machine learning, deep learning and other forms of 'artificial intelligence'. Optical Character Recognition (OCR) is often used to convert typed or hand-written text to computer-readable content. Several countries have implemented data archiving services for archaeology to manage the significant amounts of data, websites, systems, and tools produced during archaeological projects, such as the United Kingdom's Archaeological Data Service.[30]

The wider practice of DCH, incorporating DA as well as other fields, has its origins in the 1960s and 1970s, although it came to prominence in the 1990s and early 2000s with the appearance of internet technology and ubiquitous computing. The term itself is relatively recent and is primarily used in the United Kingdom, North America, Europe and Australasia. It refers to the use of digital technology to document, manage, augment, analyse, preserve and enhance user experiences related to all kinds of cultural heritage assets, from artworks to archaeological objects and buildings. The distinction between tangible and intangible heritage is normally retained. In addition to the DA applications referred to above, common techniques include: the use of database technology to manage collection metadata and display digitized copies of collection content (increasingly including the development of federated archives to connect different collections); the use of websites and social media for public engagement, communications, and citizen science; the use of Internet of Things (IoT) devices to track museum and art gallery usage and augment visitor experiences; the use of XR (virtual and augmented reality) technologies to recreate the past and provide immersive products and experiences.

Significant international funding has been allocated to DCH since the early 2000s, with major investments being made by the European Commission,[31] the United Kingdom,

[30] "Archaeology Data Service home page", Archaeology Data Service, accessed January 18, 2021, https://archaeologydataservice.ac.uk/.
[31] European Commission, "Digital Cultural Heritage". Shaping Europe's digital future - European Commission, 16 January 2015. https://ec.europa.eu/digital-single-market/en/digital-cultural-heritage.

and the United States. Australia, Canada, Asia and New Zealand are also actively engaged in funding DCH, which is viewed as a key driver of cultural identity, and an enabler of positive socio-economic outcomes. Non-governmental organisations (NGOs) such as UNESCO are also actively involved in DCH, often from the perspective of preservation, risk reduction, resilience, and economic development.[32] Flagship digital cultural heritage projects include Europeana[33] and the Internet Archive.[34] The international Galleries, Libraries, Archives and Museums (GLAM) sector are very active and use digital cultural heritage to expand their impact and institutional mission with projects such as British Library Treasures[35] and the Rijks Studio at the Rijksmuseum.[36] Commercial vendors are also involved in DCH, via projects such as Google Arts & Culture.[37] Local institutions with smaller collections often find DCH provides efficient ways of managing their assets and reaching users, using freely available tools such as Arches,[38] Omeka[39] and CKAN.[40] Recent practices have started to recognise the impact of unequal access to technology, resulting in the use of low-bandwidth products and low-cost minimal computers to increase access to local and national collections. Important (often enabling) cognate activity includes the provision of government data repositories, open access, open source, and open data initiatives, and digital humanities research that often uses, theorises or builds DCH resources.

[32] UNESCO, "Concept of Digital Heritage". UNESCO, 28 March 2019. https://en.unesco.org/themes/information-preservation/digital-heritage/concept-digital-heritage.
[33] "Europeana Collections", Europeana, accessed January 19, 2021, https://www.europeana.eu/en/collections.
[34] "Internet Archive", Internet Archive, accessed January 19, 2021, https://archive.org/.
[35] "British Library Treasures", the British Library, accessed January 19, 2021, https://www.bl.uk/british-library-treasures.
[36] "Rijks Studio", the Rijksmuseum, accessed January 19, 2021, https://www.rijksmuseum.nl/en/rijksstudio.
[37] "Google Arts & Culture", Google LLC, accessed January 19, 2021, https://artsandculture.google.com/.
[38] "Arches", Getty Conservation Institute and World Monuments Fund, accessed January 19, 2021, https://www.archesproject.org/.
[39] "Omeka", Corporation for Digital Scholarship, the Roy Rosenzweig Center for History and New Media, and George Mason University, accessed January 19, 2021, https://omeka.org/.
[40] "CKAN", The CKAN Association, accessed January 19, 2021, https://ckan.org/.

Digitization of cultural heritage is an important component of this activity, which includes content specification, digital cataloguing, digital maintenance, and digital preservation.[41]

1. **Content specification:** It is important to specify the requirements and purpose of digitization, using questions such as:
    - Why do we need digitization in cultural heritage?
    - What type of analogue content needs to be digitized?
    - What kind of digital method is used?
    - Who will benefit from these initiatives?

2. **Digital cataloguing:** This refers to the process of defining information about digital materials. This detailed information is referred to as metadata and contains, among other things, information about content, context and technical features. Multiple metadata schemes and standards are used in this process.

3. **Digital maintenance:** Data needs to be protected and maintained with appropriate infrastructure as well as techniques to manage security, bandwidth, server capacity and backup.

4. **Digital preservation:** Preserving data digitally requires very long-term management as well as short and medium-term maintenance. Digital preservation aims to guarantee technical and organizational durability as far as possible into the future (accepting known technical constraints), often involving bit-level management.

The GLAM influence in international DCH creates hard dependencies on information management standards used in cataloguing, often derived from analogue sources, that control the description and access of content[42] These standards connect DCH to activities in the commercial world, related to corporate knowledge management, although the GLAM sector is heavily oriented towards open source technologies and

[41] For a more detailed discussion of this topic please refer to the MaDiH (مديح) Technical White Paper.
[42] Please refer to the MaDiH (مديح) Technical White Paper.

open access principles as a result of alignment to government policies that increasingly foreground these policies as economic and social enablers. These include the concept of data sovereignty which aims to ensure heritage data is properly identified and described, and controlled by appropriate cultural, ethnic, or national entities.

CHALLENGES	• Identifying and storing data generated from cultural heritage management and digital archaeology. • Creating appropriate and efficient data models to represent the wide-ranging forms of data managed in DCH, including 'fuzzy' or uncertain knowledge. • Identifying legitimate and accurate metadata and the digital objects corresponding to it. • Selecting and deploying appropriate algorithms, data visualizations, infographics, data stories, and workflows to navigate, understand, and add value to the stored data. • Building a solid infrastructural foundation to support current and emerging DCH technologies. • Enhancing the availability of sustainable digital resources at the grassroots level.

RECOMMENDATIONS	• Use Jordan's deep experience in cultural heritage management and archaeology to become a global leader in DCH and DA.

RESEARCH INFRASTRUCTURES, OPEN ACCESS & OPEN SCIENCE

Digital Cultural Heritage (DCH) projects often contribute to wider **Research Infrastructures** (RI), to facilitate research outcomes and to support their long-term sustainability.[43] RIs are growing in importance internationally, as countries and regions rationalise inherited tools and systems and aim to better manage technical complexity related to large-scale computationally-intensive research. RIs are usually funded over significant periods of time, and are increasingly including 'human infrastructure' (skills, careers) and 'procedural infrastructure' (workflows, knowledge, standards) alongside technical infrastructure (servers, networks, storage facilities) in their definition. The

[43] See also A. Ciula, J. Nyhan, and C. Moulin, "ESF Science Policy Briefing on Research Infrastructures in the Digital Humanities: Landscapes, Ecosystems and Cultures", *Lexicon Philosophicum* 1 (2013): 277–87.

European Research Infrastructure Consortium (ERIC)[44] monitors, through a legal framework, key European RI projects. European Research Infrastructure for Language Resources and Technology (CLARIN)[45] is an example of an ERIC oriented towards DCH, as is the European Research Infrastructure for Heritage Science (E-RIHS);[46] achieving the status of an ERIC offers long-term funding and access to technical and administrative resources. The European Strategy Forum on Research Infrastructures (ESFRI)[47] provides high-level strategic oversight for projects such as the European Open Science Cloud (EOSC), a continent-wide project to produce interoperable cloud infrastructure to enhance scientific collaboration.[48]

All international RIs exist to "foster the definition, implementation and further development of advanced solutions for the effective provisioning and use of high quality scientific data, with effective metadata descriptors, ease of access, interoperability and reusability, fully implementing the FAIR (Findable, Accessible, Interoperable, and Reusable) principles".[49] New infrastructures are being designed to ensure cultural heritage collections can be analysed using data science techniques such as machine learning.[50] Similar RIs exist in the United States, Canada, and New Zealand, and international interoperability is becoming more common.

The United Kingdom's RI ecosystem is managed by UK Research & Innovation (UKRI), and is under active development through a landscape mapping report[51] and an opportunity for growth report.[52] UK strategy includes support for DCH and archaeology,

[44] "European Research Infrastructure Consortium (ERIC)", European Commission, accessed January 19, 2021, https://ec.europa.eu/info/research-and-innovation/strategy/european-research-infrastructures/eric_en.
[45] "CLARIN - European Research Infrastructure for Language Resources and Technology", European Commission, accessed January 19, 2021, https://www.clarin.eu/.
[46] "E-RIHS - European Research Infrastructure for Heritage Science", European Commission, accessed January 19, 2021, http://www.e-rihs.eu/
[47] "European Strategy Forum on Research Infrastructures (ESFRI)", European Commission, accessed January 19, 2021, https://www.esfri.eu/.
[48] "European Open Science Cloud (EOSC)", European Commission, accessed January 19, 2021, https://www.eosc-portal.eu/.
[49] "ESFRI, High-quality open research data and role of ESFRI in EOSC", ESFRI, accessed January 19, 2021, https://www.esfri.eu/esfri-white-paper/25-high-quality-open-research-data-and-role-esfri-eosc.
[50] Barbara McGillivray, Beatrice Alex, Sarah Ames, Guyda Armstrong, David Beavan, Arianna Ciula, Giovanni Colavizza et al. "The challenges and prospects of the intersection of humanities and data science: A white paper from The Alan Turing Institute." (2020) https://doi.org/10.6084/m9.figshare.12732164.v2.
[51] UKRI, *The UK's research and innovation infrastructure: Landscape Analysis* (UKRI, 2020) https://www.ukri.org/files/infrastructure/landscape-analysis-final-web-version/.
[52] UKRI, *The UK's research and innovation infrastructure: opportunities to grow our capability* (UKRI, 2020) https://www.ukri.org/files/infrastructure/the-uks-research-and-innovation-infrastructure-opportunities-to-grow-our-capacity-final-low-res/.

and the wider UK landscape includes the UK Archaeological Data Service (ADS), which supports long-term storage of digital content.[53] ADS was established in 1996. It is an accredited digital repository, designed to support heritage data generated by UK-based archaeological fieldwork and research. The European ARIADNE Plus project provides a data infrastructure for the global archaeological community.[54] Digital repositories such as MEGA-Jordan[55] can also be considered RIs, although they have not been integrated into a larger national or international context. Peter McKeague et al. discuss the issues associated with RIs for archaeology, noting their substantial potential but also challenges in funding, designing, and maintaining them.[56] Large-scale RIs exist to promote the long-term sustainability of DCH systems and data, alongside other scientific disciplines. Governments invest in them to ensure they get return on investment from funding initiatives, and that funded projects share their content openly in the interests of high-quality scientific method. Open access to digital content is facilitated by RIs through initiatives such as the FAIR metadata initiative and organisations such as the Research Data Alliance (RDA),[57] which promote metadata standards and best practices to properly describe research data and enhance interoperability between datasets. Such initiatives are closely associated with library and archival science, national organisations such as the UK Archives and Records Association,[58] and international standards authorities such as the International Organization for Standardization (ISO).[59]

Together, RIs and related organisations contribute to open access, which aims to support the OECD's goal of making "the primary outputs of publicly funded research results – publications and the research data – publicly accessible in digital format with

[53] "Archaeology Data Service home page", Archaeology Data Service, accessed January 18, 2021, https://archaeologydataservice.ac.uk/.
[54] "ARIADNE Plus", Ariadne infrastructure, accessed January 19, 2021, https://ariadne-infrastructure.eu/.
[55] "MEGA-Jordan", The Department of Antiquities, the Getty Conservation Institute and World Monuments Fund, accessed January 19, 2021, http://megajordan.org/.
[56] Peter McKeague, Rein van't Veer, Isto Huvila, Anne Moreau, Philip Verhagen, Loup Bernard, Anwen Cooper, Chris Green, and Niels van Manen., "Mapping Our Heritage: Towards a Sustainable Future for Digital Spatial Information and Technologies in European Archaeological Heritage Management". *Journal of Computer Applications in Archaeology*, 2(1), (2019): 89–104, DOI: http://doi.org/10.5334/jcaa.23.
[57] "Research Data Alliance", The Research Data Alliance (RDA) Foundation, accessed January 19, 2021, https://www.rd-alliance.org/.
[58] "UK Archives and Records Association", The Archives and Records Association, accessed January 19, 2021, https://www.archives.org.uk/.
[59] "International Organization for Standardization (ISO)", International Organization for Standardization (ISO), accessed January 19, 2021, https://www.iso.org/home.html.

no or minimal restriction".[60] The practice has evolved significantly in the last few years, to encompass the entire research process, from project design and data acquisition / creation through to the development of workflows to aid analysis and Research Data Management (RDM) infrastructure and processes to ensure longevity. Most research-intensive institutions have RDM repositories and procedures to help researchers select, curate, retain and store their research data.

National and international RIs are normally enabled by open source software that is freely available (although it requires investment for implementation and maintenance). This allows the community to share and contribute to the latest technologies, align to open standards, and share open workflows, processes, and content. In all cases, digital content is access controlled, to ensure sensitive content is protected.

CHALLENGES	• Ensure Jordan's DCH community requirements are included in any future Jordanian RI strategy.
RECOMMENDATIONS	• Contribute Jordanian content to international initiatives such as ARIADNE Plus.

Jerash Archaeological site
(CC BY-NC-SA), Shatha Mubaideen

[60] OECD, OECD Principles and Guidelines for Access to Research Data from Public Funding. http://www.oecd.org/sti/inno/38500813.pdf

RESEARCH SOFTWARE ENGINEERING

Research Software Engineers (RSE) have existed for decades, but the job title is relatively new. It started to be used in the UK in 2013,[61] and has since developed into a Society of Research Software Engineering[62] with new national initiatives in the United States, Germany, and New Zealand. "A Research Software Engineer (RSE) combines professional software engineering expertise with an intimate understanding of research".[63] This extends to fields such as archaeology and cultural heritage management, where RSEs work with cultural heritage professionals as well as researchers, defining technical requirements and translating them into digital products. The assumption is that DCH infrastructure benefits from people dedicated to its long-term maintenance, and who can 'translate' between people involved in practical, technical, and intellectual work. By defining clear career paths[64] for those people, and providing them with training[65] and professional opportunities, investments made in digital infrastructure are more likely to be realised. RSEs can also play an important role in building ties between government, commercial, and higher education sectors.

CHALLENGES	• Build RSE training into Jordanian cultural heritage and higher education contexts. • Fund RSE roles in Jordanian cultural heritage and higher education institutions.
RECOMMENDATIONS	• Build a cohort of Jordanian RSEs committed to the long-term development of DCH infrastructure, and the production of DCH products and services. • Foster technical ties between cultural heritage institutions, Jordanian government, commercial, and higher education sectors.

[61] Simon Hettrick, "A not-so-brief history of Research Software Engineers", Software Sustainability Institute, August 17, 2020. https://www.software.ac.uk/blog/2016-08-17-not-so-brief-history-research-software-engineers-0. For a discussion of similar issues in relation to the humanities see Nicolas Gold, 'Service-Oriented Software in the Humanities: A Software Engineering Perspective', *Digital Humanities Quarterly* 3, no. 4 (20 March 2010).
[62] "Society of Research Software Engineering", Society of Research Software Engineering, accessed January 19, 2021, https://society-rse.org/.
[63] "Society of Research Software Engineering", About, accessed January 19, 2021, https://society-rse.org/about/
[64] James Smithies, "Research Software (RS) Careers: Generic Learnings from King's Digital Lab, King's College London". Zenodo, February 7, 2019. https://doi.org/10.5281/zenodo.2564790.
[65] "King's Digital Lab MaDiH's (مديح) RSE Training", European DARIAH-Campus, accessed January 19, 2021, https://campus.dariah.eu/resource/rse2019.

DIGITAL MULTILINGUALISM

Digital technology has traditionally been dominated by the English language, as a global lingua franca but also as the first language of dominant technology companies who design and market devices and software. The rapid growth of technology in non-Western communities has increased awareness about the cultural but also technical implications of this.[66] This observation is connected to a more general 'monolingual mindset' which results in much of the world's digitized output being in English, including in the humanities and other research fields.[67] This attitude, which particularly affects languages with non-Latin scripts (NLS), challenges digital linguistic diversity and can foster a further disconnection between the (digital) cultural heritage and the peoples to whom that heritage belongs.[68]

More focus on digitization of NLS and investment in Optical Character Recognition (OCR) and associated NLP multilingual corpora and technologies capable of recognising, parsing and translating digitised content is needed to ensure global digital linguistic diversity. It is also important to recognise the limitations of automated translation services (including Google Translate) and invest in high quality manual translation wherever feasible. Recognition of issues associated with digital monolingualism have resulted in the establishment of Global Outlook::Digital Humanities (GO::DH), a Special Interest Group (SIG) of the Alliance of Digital Humanities Organizations (ADHO), which aims "to help break down barriers that hinder communication and collaboration among researchers and students of the digital arts, humanities, and cultural heritage sectors in high, mid, and low Income economies".[69] This extends to providing advice about the development of local digital capability across the world, and advice to enhance digital multilingualism.

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[66] It is worth noting that although archives and repositories can be made bi-lingual relatively easily at a surface level (in terms of the user interface) it is often considerably more difficult to deliver complete bi-lingualism at the level of individual database fields and related search functions. Bi-lingual requirements should be included in the very early design phase of digital assets to avoid such issues.

[67] Paul Spence, "Introduction, Disrupting Digital Monolingualism Online Workshop 16th-17th June 2020", accessed August 5, 2020, https://www.youtube.com/watch?v=G1oGc8tYnCM&feature=youtu.be.

[68] Cosima Wagner, "Challenging research infrastructures from a multilingual DH point of view, Disrupting Digital Monolingualism Online Workshop 16th-17th June 2020", accessed August 5, 2020, https://www.youtube.com/watch?v=cKIapqc4Ncw&feature=youtu.be.

[69] "Global Outlook::Digital Humanities", ADHO, accessed January 19, 2021, https://adho.org/global-outlookdigital-humanities-godh. The Alliance of Digital Humanities Organizations (ADHO) also supports other initiatives to foster multilingualism, such as their Multi-lingualism & Multi-Culturalism Committee (https://adho.org/administration/multi-lingualism-multi-culturalism).

CHALLENGES	• Ensure Jordanian DCH has high quality Arabic and English content. • Ensure Jordanian DCH has the same functionality in Arabic and English. • Ensure Jordanian DCH is richly multi-lingual, with high quality Arabic translations of languages such as French, German, Italian.
RECOMMENDATIONS	• Jordan's expertise in Arabic - English translation could position it as a centre of excellence for digital multilingualism. • Jordan's expertise in Arabic - English translation could make it an attractive partner for technology companies and open source initiatives interested in 'localisation' of content.

Inscriptions in Al-Harra,
(CC BY-NC-SA), Shatha Mubaideen

JORDANIAN POLICY CONTEXT

CULTURAL HERITAGE IN JORDAN

As the MaDiH data catalogue shows, Jordan has many and diverse cultural heritage assets, including movable and immovable tangible heritage and intangible heritage,[70] (as further detailed in the 'Data collection' section below). Internationally it is famous for its archaeology, and especially for the World Heritage Site of Petra. Archaeological site compilations such as the MEGA-Jordan[71] and EAMENA[72] databases show that there are, however, tens of thousands of small and large sites in Jordan. Many more remain undocumented. 'Non-archaeological' heritage, or heritage from after 1750 CE (see also below), is also well represented (e.g., in 62% of datasets in the MaDiH catalogue). In addition, Jordan has a substantial intangible heritage, as is again clear from the MaDiH catalogue, where 40% of the datasets contain reference to intangible heritage.

This richness of (preserved) heritage presents a large challenge, especially in combination with expanding agricultural and urban development. At the same time, however, it provides opportunities beyond the academic and heritage sectors. For example, tourism & hospitality formed 10% of Jordan's GDP in 2016, and was planned to grow by 5% by 2022.[73] Cultural heritage, both tangible and intangible, forms a, if not the, major attraction to international and Jordanian tourists, with Petra receiving over 1.1 million visitors in 2019, or just over 20% of the total number of the more than 5.3 million tourists that year.[74]

[70] Flohr et al. in preparation; Although only in its first, exploratory phase, the MaDiH data catalogue is representative of Jordanian cultural heritage datasets, for example containing information on cultural heritage databases that exist or are in an advanced stage of development for Jordanian cultural heritage (such as MEGA-Jordan, EAMENA, DOJAM; detailed below). Note that natural heritage datasets were not recorded, although when natural heritage was present in a cultural heritage dataset this was noted.
[71] "MEGA-Jordan", The Department of Antiquities, the Getty Conservation Institute and World Monuments Fund, accessed January 19, 2021, http://megajordan.org/.
[72] "EAMENA database", The EAMENA project, accessed January 19, 2021, https://database.eamena.org/.
[73] "Jordan Economic Growth Plan 2018-2022", The Economic Policy Council, accessed January 19, 2021, www.egp.jo.
[74] "Tourism Statistical 2019", The Ministry of Tourism and Antiquities, accessed October 19, 2021, https://www.mota.gov.jo/contents/Statistics.aspx.

Cultural heritage policy in Jordan

Jordan has ratified several international charters and conventions on protecting cultural heritage, both tangible (e.g., the UNESCO 1972 Convention concerning the Protection of Cultural and Natural Heritage) and intangible (e.g., the UNESCO 2003 Convention for the Safeguarding of the Intangible Cultural Heritage).[75]

In Jordanian law and policy, cultural heritage is divided into tangible and intangible. Tangible cultural heritage is further divided into that dated before 1750 CE[76] ("athar", translated as "archaeology" or "antiquities") and that dated after 1750 CE ("turath", often translated as "heritage"). These three categories are governed by separate government ministries and departments and fall under different legislation.[77] This separation has far-reaching consequences, as they are not only treated differently legally and in policy, and therefore in heritage protection, but also in education, local and international public perception.

For tangible heritage from before 1750 CE, the Department of Antiquities of Jordan (DoA) is the official responsible authority, and they in turn report to the Ministry of Tourism and Antiquities (MoTA). Their implementation of archaeological policy is mandated by the Law of Antiquities No. 21 for the Year 1988 and its subsequent amendments.[78] According to this law, "antiquities" include movable and immovable objects "made, written, inscribed, built, discovered or modified by a human being before the year AD 1750", but in addition also those dating to after AD 1750 "which the Ministry requests to be considered an antiquity…". In addition, "human, animal and plant remains which date back to before AD 600" fall under this law.[79] The law allows punishment of people who "destroy, ruin, disfigure, or cause damage to antiquities",[80]

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[75] UNESCO, *Convention concerning the protection of the World Cultural and National Heritage* (UNESCO, 1972) https://whc.unesco.org/en/conventiontext/, and UNESCO, *Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO, 2003)* https://ich.unesco.org/en/convention.

[76] "Common Era", equivalent of AD.

[77] See Hassan, Fekri, Aloisia de Trafford, Mohsen Youssef, and I. Serageldin. "Cultural heritage and development in the Arab world." *Alexandria: Bibliotheca Alexandrina* (2008); Palumbo, G. "Twenty-five years of archaeological site inventories in the Middle East: Challenges and perspectives". *Change Over Time* 2(1) (2012): 20-31.

[78] Maysoon Al-Qaatarneh, "Conserving the archaeological heritage in Jordan is the mission of the Department of Antiquities". Paper presented at the JOCHERA Final Conference (2013); Jordanian Law of Antiquities, The Law No. 21 for the year 1988 promulgated in the Official Gazette, issue No. 3540 dated 17/3/1988 and the amending Law No. 23 for the year 2004 promulgated in the Official Gazette, issue No. 4662 dated 1/6/2004.

[79] The Department of Antiquities, *Jordanian Law of Antiquities and its amendments* (The Department of Antiquities, 2004).

[80] The Department of Antiquities, *Jordanian Law of Antiquities and its amendments:* Article 9 (The Department of Antiquities, 2004).

with imprisonment and a fine.[81] However, with tens of thousands of archaeological sites in the country, this is hard to enforce in practice.

Tangible heritage dating after 1750 CE, such as Ottoman and 20th-century heritage sites and built heritage, falls directly under the Ministry of Tourism and Antiquities, and not under the Department of Antiquities. This heritage, turath, will be protected under the 2005 Law for the Protection of Urban and Architectural Heritage.[82] However, this law is not activated yet; first a national record of heritage architecture needs to be established and approved by a committee consisting of the Ministry of Tourism and Antiquities, the Ministry of Planning (MoP), the Greater Amman Municipality (GAM), and heritage professionals.[83] Intangible cultural heritage is the responsibility of the Ministry of Culture, who ensure the development of cultural plans and projects to document this heritage and who raise public awareness through publications, arts, and folklore events. There are no specific laws or other regulations on the conservation or digitization of intangible cultural heritage in Jordan. However, the 2003 UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage was ratified in 2006 and since then the issue has become part of the National Agenda and a Department for Intangible Cultural Heritage has been erected within the Ministry, responsible for setting and implementing a national strategy.[84]

In practice, in addition to the Ministries and the DoA, municipal government (e.g. GAM), royal institutions like the Royal Hashemite Documentation Centre and the Royal Jordanian Geographic Centre, non-governmental organisations, international research institutions, Jordanian and foreign universities, as well as individuals are also involved in heritage documentation, interpretation, and protection in Jordan.

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[81] The Department of Antiquities, *Jordanian Law of Antiquities and its amendments:* Article 26, 27 and 28 (The Department of Antiquities, 2004).
[82] Also known as the Heritage Law or Law No. 5 of 2005 on the Protection of Architectural and Urban Heritage; Al Rabady, Rama, Shaher Rababeh, and Shatha Abu-Khafajah. "Urban heritage governance within the context of emerging decentralization discourses in Jordan." *Habitat International* 42 (2014): 253-263. Jordanian Government, *Law No. 5 of 2005 on the Protection of Architectural and Urban Heritage (*Jordanian Government, 2005) https://wipolex.wipo.int/en/legislation/details/11237.
[83] F. Rabady, Personal Communication, 24 November 2019.
[84] Hani Hayajneh, "The legal protection of the intangible cultural heritage in the Hashemite Kingdom of Jordan" 2019 in P.L. Petrillo (ed.) The legal protection of the intangible cultural heritage, https://doi.org/10.1007/978-3-319-72983-1_6 ; see also UNESCO, *National Assessment of the State of Safeguarding Intangible Cultural Heritage (ICH) in Jordan* (UNESCO, 2009) http://inform.gov.jo/en-us/By-Date/Report-Details/ArticleId/90/National-Assessment-of-the-State-of-Safeguarding-Intangible-Cultural-Heritage-ICH-in-Jordan.

CHALLENGES	• Jordanian cultural heritage policy divided over different governmental ministries and departments. • Large amount of and diverse cultural heritage; in practice hard to protect. • Law for protecting heritage of after 1750 CE not implemented yet; no specific law for protecting intangible cultural heritage yet.
RECOMMENDATIONS	• Jordan has ratified international charters on tangible and intangible heritage. Gaps in coverage should be identified and filled. • Increased collaboration between Ministries and Departments and other heritage organisations to link policy and to (digitally) connect data collection and storage between athar, turath, and intangible cultural heritage.

DIGITAL CULTURAL HERITAGE IN JORDAN

Due to the divided policy context (tangible and intangible; within tangible divided into before and after 1750 CE; as discussed above), but also due to different research traditions for each of these, Jordanian DCH practices also tend to be divided. Despite this fragmentation, the country has been a regional leader in DCH, showing an openness to developing technical capacities for the use of cultural heritage documentation.

Over the last decades, considerable efforts have been made especially in the pre-1750 tangible heritage (athar/archaeology), hereafter 'archaeology', field. In the 1990s, information about thousands of published archaeological sites was compiled in the Jordan Antiquities Database and Information System (JADIS), which exist as a published book and as a database on a computer stationed in the Department of Antiquities (DoA) offices in Amman.[85] In 2010 this data was transferred to the new MEGA-Jordan spatial (GIS) database, a forerunner of the open source Arches platform.[86] This English-Arabic database was, and remains, unique in the region in that

[85] Gaetano Palumbo, "JADIS: the Jordan Antiquities Database and Information System; A Summary of the Data." (1994).
[86] "MEGA-Jordan", The Department of Antiquities, the Getty Conservation Institute and World Monuments Fund, accessed January 19, 2021, http://megajordan.org/; David Myers and

it is available online and can therefore be accessed from anywhere with an internet connection, allowing for data entry and use by different DoA offices and international research projects; indeed it is widely used within the DoA for heritage management purposes. In addition, some of the data can be accessed without logging in, thus forming an excellent, widely used research resource.[87] At the time of writing, the MEGA-Jordan database is being upgraded to Arches version 5 in collaboration with the EAMENA project[88] and the Getty Conservation Institute. There are also datasets on Jordanian archaeological sites hosted and administered from outside Jordan, such as the EAMENA Arches database.[89]

In contrast, data on movable tangible heritage (i.e., archaeological finds and objects) has not yet been centrally compiled. Excavation inventory lists are held by the DoA, and museums have digital and/or analogue records of their objects, but these are often not available online (out of 28 Jordanian museum datasets in the MaDiH catalogue, only 9 are accessible online). However, with 24 of the 28 recorded datasets of museums in Jordan being in digital form there is scope to make these available online.[90] The newly developed DOJAM database could be an excellent platform for this, at least for archaeological objects.[91]

Alison Dalgity, "The Middle Eastern Geodatabase for Antiquities (MEGA): an open source GIS-based heritage site inventory and management system" *Change Over Time* 2, no. 1 (2012): 32-57. "Arches", Getty Conservation Institute and World Monuments Fund, accessed January 19, 2021, https://www.archesproject.org/.

[87] Mariusz Drzewiecki and Mahmoud Arinat, "The Impact of Online Archaeological Databases on Research and Heritage Protection in Jordan", *Levant* 49 (2017), https://doi.org/10.1080/00758914.2017.1308117.

[88] "EAMENA", The EAMENA project, accessed January 19, 2021, https://eamena.org/.

[89] "EAMENA database", The EAMENA project, accessed January 19, 2021, https://database.eamena.org/; also for example the Digital Archaeological Atlas for the Holy Land by Steven Savage, https://daahl.ucsd.edu/DAAHL/.

[90] https://madih-data.kdl.kcl.ac.uk/dataset?groups=museums-in-jordan&_tags_limit=0; there are also other museums in Jordan not yet recorded in MaDiH.

[91] Documentation of Objects in Jordanian Archaeological Museums project, a cooperation between the German Protestant Institute of Archaeology (GPIA) and the DoA; this is a museum management database with a particular initial focus on and tested for the Jordan Archaeological Museum, but designed to be scalable to all of Jordan's archaeological museum objects.
"Documentation of the Objects in Jordanian Archaeological Museums (DOJAM)", GPIA Amman, accessed January 19, 2021, https://www.zitadelle-amman.de/projekt/; In February 2021 it was announced that further funding had been acquired to roll out the database to all of Jordan's archaeological museums that fall under the DoA (GPIA Facebook page, February 1, 2021).

For tangible heritage dating to after 1750 CE, there is not yet one collating database. As is clear from the MaDiH CKAN catalogue, there are many initiatives for digital documentation, but they have not been collected in one place. Especially notable, however, and possibly forming the basis for such a collation, is the GAM's offline register of heritage houses (Arabic only).[92] In addition, in the EAMENA database all heritage up to 1950 CE is recorded, and for example the Amman Heritage Houses project has been adding information there.[93]

For intangible cultural heritage, the Ministry of Culture's National Project for the Documentation of Intangible Heritage gives an inventory of five of the governorates (in Arabic only).[94] The Ministry of Culture's Memory of Jordan project, part of the UNESCO Memory of the World project, does not yet have a database, but aims to collect intangible heritage in audio-visual form and as historical documents over the next years, if it is successful in gaining funding.[95]

There are also other DCH collation initiatives, often including 'archaeology', 'heritage', as well as intangible heritage. For example, photo archives, like APAAME,[96] the ACOR photo archive,[97] and Manar al-Athar,[98] include photographs of archaeology, but also of later remains, and in some cases document intangible cultural heritage. In some cases, the (historical) photographs themselves are 'heritage' too. Other DCH in Jordan includes digitization projects, like the DoA's digitization of their journals, now available open access online,[99] or plans by the Royal Jordanian Geographic Centre and Department of Antiquities' initiatives for digitising maps.[100] Other, although much less common, initiatives include for example photogrammetry and 3D modelling.

[92] "Greater Amman Municipality", GAM, accessed November 20, 2021, https://www.ammancity.gov.jo/ar/main/index.asp.
[93] Mubaideen et al. in preparation.
[94] "Intangible heritage of Jordan publications", Heritage Directorate, the Ministry of Culture, accessed January 19, 2021, http://ich.gov.jo/node/52332.
[95]First Preparatory Workshop for the Memory of Jordan project, 6 January 2020; "The Ministry of Culture is organizing the "First Preparatory Workshop for the Jordan Memory Project" at the Royal Cultural Center", Ministry of Culture, http://www.ich.gov.jo/node/70047, accessed January 27, 2021.
[96] "APAAME", APAAME Team, accessed January 19, 2021, www.apaame.org.
[97] "ACOR Photo Archive", ACOR, accessed January 19, 2021, photoarchive.acorjordan.org.
[98] "Manar Al-Athar", Oxford University, accessed January 19, 2021, http://www.manar-al-athar.ox.ac.uk/.
[99] "The Department of Antiquities Online Publications Archive", The Department of Antiquities, accessed January 19, 2021, http://publication.doa.gov.jo/.
[100] H. Al-Syouf, Personal Communication 17 October 2019; E. Samara, Personal Communication 17 December 2019. No plans exist yet though for these to be made available online.

There is therefore a wealth of digital data related to Jordanian cultural heritage, but it is often not collated in one place, but rather dispersed over many online and offline archives. Because of this, it is difficult to find what one needs, which is what the MaDiH catalogue aims to help with. The fact that 93% of the data is at least partly digital offers clear opportunities for further data aggregation, partial federation, or Linked Open Data initiatives.

In light of the above, based on the data collected by MaDiH, it is interesting to see that there is a strong contrast between datasets collected and held in Jordan and those abroad, especially outside the MENA (Middle East and North Africa) region. While both focus on tangible heritage, the datasets curated in Jordan also often contained data on intangible heritage (62% of datasets), outside Jordan this was only 18-29%. Partly related to this, the datasets held in Jordan often contained data on post-1750 AD heritage (91% of the datasets), but much less on pre-1750 AD (26%). In contrast, in Europe, the UK, and the USA (where most of the datasets outside Jordan are being held) the focus lies on pre-1750 AD archaeology (72-78%) and much less on post-1750 AD heritage (32-58%).

CHALLENGES	• Datasets are often scattered over many different repositories and projects. • As with many countries, data quality is often uneven and lacking in standards compliance.
RECOMMENDATIONS	• Continue the collation of archaeological sites in MEGA-Jordan; establish an online database for post-1750 heritage; expand online availability of the ICH database(s). • Integrate these databases, e.g. through Linked Open Data, at a single online access point. • Leverage the relatively high ratio of digital datasets identified by the MaDiH project, to aggregate content, develop products etc. • Build on Jordan's existing regional leadership in DCH. • Leverage Jordan's openness to and knowledge of DCH. and open access principles. • Use existing DCH infrastructure in Jordan as a foundation for data sovereignty.

OPEN SCIENCE & RESEARCH INFRASTRUCTURE IN JORDAN

Digital Cultural Heritage is closely related to the broader development of Open Science, primarily through the deployment of digital tools to support research in archaeology and cultural heritage management. Spellman, Gilbert, and Corker provide a good definition of this practice:

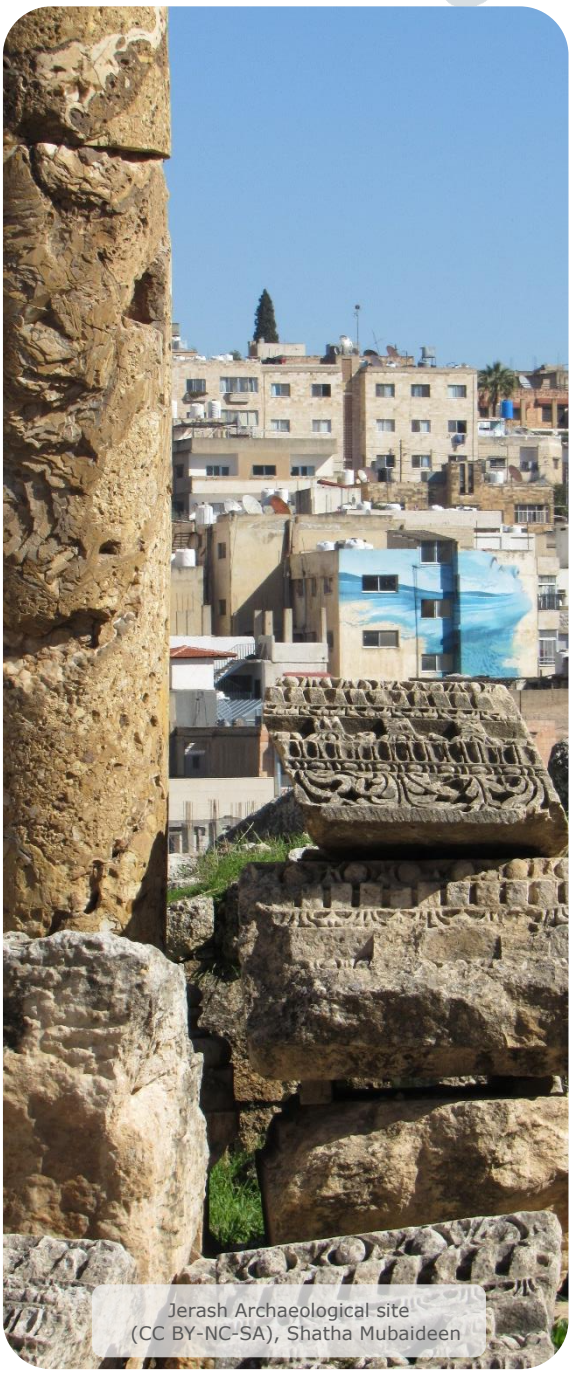
> Open Science is a collection of actions designed to make scientific processes more transparent and results more accessible. Its goal is to build a more replicable and robust science; it does so using new technologies, altering incentives, and changing attitudes.[101]

Jordan's governmental focus on open access scholarship and open source technology positions it well to increase its capacity in Open Science and, in particular, to increase its capacity in enabling research infrastructures that support it. This potential is further strengthened through initiatives such as the Jordan Open Source Association (JOSA),[102] and open access scholarly journals such as *The Research Bulletin of Jordan ACM Chapter - ISWSA*,[103] the *International Journal of Advances in Soft Computing and Its Applications*,[104] the *International Journal of Open Problems in Computer Science and Mathematics*,[105] and the *Jordan Journal of Biological Sciences*.[106] The *Annual of the Department of Antiquities in Jordan* (ADAJ)[107] and the *Jordan Journal for History and Archaeology* (JJHA)[108] are also relevant.

The Royal Hashemite Documentation Center in Archiving and Restoration[109] is a particularly valuable asset in the context of DCH. Founded in 2005, the Center restores

[101] Bobbie Spellman, Elizabeth Gilbert, and Katherine S. Corker, "Open Science: What, Why, and How",18 April 2017, https://doi.org/10.31234/osf.io/ak6jr.
[102] "The Jordan Open Source Association", JOSA, accessed January 19, 2021, https://jordanopensource.org/.
[103] "IJJ: The Research Bulletin of JORDAN ACM - ISWSA", JORDAN ACM Professional Chapter - ISWSA, accessed January 19, 2021, http://ijj.acm.org/.
[104] "The International Journal of Advances in Soft Computing and Its Applications", IJASCA, accessed January 19, 2021, http://www.home.ijasca.com/.
[105] "International Journal of Open Problems in Computer Science and Mathematics (IJOPCM)", International Center for Scientific Research and Studies, accessed January 19, 2021, http://www.ijopcm.org/.
[106] "Jordan Journal of Biological Sciences", The Hashemite University, accessed January 19, 2021, http://jjbs.hu.edu.jo/.
[107] "The Department of Antiquities Online Publications Archive", The Department of Antiquities, accessed January 19, 2021, http://publication.doa.gov.jo/.
[108] "Jordan Journal for History and Archaeology (JJHA)", The University of Jordan, accessed January 19, 2021, https://journals.ju.edu.jo/JJHA.
[109] "The Royal Hashemite Documentation Center", RHDC home page, accessed January 19, 2021, https://www.rhdc.jo/

historical archives, from the period of the Emirates of Transjordan to the Ottoman and Contemporary periods and has significant capabilities. The presence of the SESAME synchrotron facility[110] provides further impetus towards open research infrastructures (RI) and Open Science, by increasing the requirements for data management and research best practices, and acting as a driver for integration with wider sectoral ICT policies and infrastructure that enable networking, storage, and human capacity. In those senses Jordan has a similar, although evolving, RI footprint to countries such as the UK but it is different to those countries - and therefore has different needs for strategic investment - because of the central importance of cultural heritage management to its economic future.[111]


Jerash Archaeological site
(CC BY-NC-SA), Shatha Mubaideen

Infrastructures such as MEGA-Jordan,[112] and the other datasets described in the MaDiH CKAN catalogue (see Analysis, below) provide content-rich foundations for a robust and wide-ranging national RI enabling of DCH but also fundamental research in fields such as archaeology, architecture, history, and supporting fields. According to a key survey of research professionals who rely on Jordanian DCH RI, this infrastructure is central to their work but contains inconsistent and sometimes

[110]"SESAME: Synchrotron-light for experimental science and application in the Middle East", SESAME home page, accessed January 25, 2021, https://www.sesame.org.jo/
[111] As part of the 'fertile crescent', Jordan also has a deep biological heritage, including wild crop relatives and progenitor species. These resources are vital to Jordan's economic future too and require protection.
[112] David Myers and Alison Dalgity, "The Middle Eastern Geodatabase for Antiquities (MEGA): an open source GIS-based heritage site inventory and management system." *Change Over Time* 2, no. 1 (2012): 32-57.

unreliable data lacking in standardisation and transliteration of key information such as locations.[113]

The development of EAMENA, a database focused on archaeological sites developed using the Arches[114] database system, suggests the potential to augment Jordan's RI through targeted investment in new cloud-based tools designed using international technical standards and implemented with high-quality training programmes.[115]

Enabling Jordanian DCH therefore requires alignment to and investment in broad kinds of national RI capable of enabling the full spectrum of research activity in the country. This activity is already underway, but more cognisance is needed of the centrality of DCH to the economic foundations of the Jordanian economy and society, so it can be properly integrated into that larger vision. MaDiH (مديح) has contributed to this process by starting to define the 'data landscape' of DCH, but any future work would ideally be undertaken in parallel to cross-disciplinary research initiatives and government-wide digital strategy.

CHALLENGES	• Ensuring investment in research infrastructure includes support for research software engineering careers. • Integration of scientific and cultural heritage infrastructures.
RECOMMENDATIONS	• Align government digital strategy with emerging research infrastructures and cross-disciplinary Open Science. • Use the experience in DCH evidenced in the MaDiH CKAN catalogue to contribute to wider national efforts to increase capacity in RI and Open Science. • Integration of DCH in national RI policies and roadmaps.

[113] Mariusz Drzewiecki and Mahmoud Arinat, 'The Impact of Online Archaeological Databases on Research and Heritage Protection in Jordan', *Levant* 49 (2017), https://doi.org/10.1080/00758914.2017.1308117.
[114] "Arches", Getty Conservation Institute and World Monuments Fund, accessed January 19, 2021, https://www.archesproject.org/.
[115] Andrea Zerbini, "Developing a Heritage Database for the Middle East and North Africa", *Journal of Field Archaeology* 43, no. sup1 (31 October 2018): S9–18, https://doi.org/10.1080/00934690.2018.1514722.

RESEARCH SOFTWARE ENGINEERING IN JORDAN

Research Software Engineering (RSE) is a new career path internationally (see above), and has not been widely adopted in Jordan. Connections across the social sciences, arts & humanities, and GLAM sector RSE could be built through continued collaboration with King's Digital Lab, along with the development of new connections with RSE teams at The National Archives of the UK, The Alan Turing Institute, and UK universities such as Oxford, Sheffield, and Exeter. The MaDiH (مديح) project was presented at the UK RSE2019 conference in Birmingham, suggesting potential for collaboration and dissemination of Jordanian RSE activities in the United Kingdom.[116] The Society of Research Software Engineering is also likely to welcome Jordanian colleagues.[117]

There is significant potential for growth in Jordanian RSE, in the same manner as other countries. Many people involved in IT support in the higher education sector could be classified as RSE, and there is scope for RSE career pathways to be developed in conjunction with computer science courses, providing an applied aspect for students interested in working in research contexts. There are eleven Software Engineering programs at the bachelor's level and two programs at the master's level in Jordanian universities.[118]

The software development industry in Jordan is growing rapidly, suggesting opportunities for cross-sector collaboration between RSEs and industry - a potentially powerful synergy in terms of technology transfer from universities to the wider economy.[119] The development of RSE careers would have important additional benefits of improving software sustainability, and open science methods.

[116] James Smithies et al., "Research Software Engineering in Jordan: The MaDiH (مديح) Project" (RSE2019, Birmingham, 2019).
[117] "Society of Research Software Engineering", Society of Research Software Engineering, accessed January 19, 2021, https://society-rse.org/.
[118] Fawaz Al-Zaghoull, Amjad Hudaib, and Majdi Ahed, "Software engineering education in Jordan" In *the 6th International Conference on Computer Science and Information Technology (CSIT)*, pp. 127-132. IEEE, 2014.
[119] Nuha El-Khalili and Dima Damen, "Software engineering practices in Jordan" In *The 4th International Multi conference on Computer Science and Information Technology, Amman, Jordan*, vol. 4, no. 4. 2006.

CHALLENGES	• Identifying people in existing roles who would benefit from being designated RSE. • Building awareness of RSE as a career path within the higher education sector.
RECOMMENDATIONS	• Improve recruitment and retention of high skilled RSEs. • Improve the quality of computational methods and open science. • Improve the sustainability of research software and infrastructure. • Build connections with the international RSE community. • Encourage funding agencies to offer funding for RSE fellowships, apprenticeships, and internships based in Jordan and abroad.

GOVERNMENT POLICY

DIGITAL TRANSFORMATION

Jordan is a regional leader in developing, adopting and using information and communication technology.[120] The Jordanian government has supported this by launching several digital initiatives to transform the country's digital capacity, viewing it as a key enabler of sustainable development.[121] These initiatives are currently led by the Ministry of Digital Economy and Entrepreneurship (MoDEE).

In 2016 the country developed the REACH2025 Digital Economy Action Plan, which aims to use digital technology to increase GDP growth by 3% to 4%, increase the digital

[120] Ministry of Information and Communications Technology, *Jordan National Information and Communications Technology (ICT) Strategy,* (MoICT, 2013) http://inform.gov.jo/en-us/By-Date/Report-Details/ArticleId/74/Jordan-National-Information-and-Communications-Technology-ICT-Strategy.
[121] Abu Shanab, Emad, and Qasem Al-Radaideh, "Jordan's E-Government Program: A User Centered Approach." (2009); Ottoum, Issa SI., "Launching E-Government in Jordan", *World of Computer Science & Information Technology Journal* 5, no. 4 (2015); Majdalawi, Yousef Kh, Tamara Almarabeh, Hiba Mohammad, and Wala Quteshate, "E-government strategy and plans in Jordan." *Journal of Software Engineering and Applications* 8, no. 04 (2015): 211.

sectors' revenue by up to 30%, add 130,000 to 150,000 jobs, and establish as many as 5,000 to 7,000 new businesses in the digital economy.[122] REACH2025 is a holistic, all of government plan of central importance to DCH and by extension the cultural heritage sector as a whole. By initiating a sector-wide digital transformation, REACH2025 positions the cultural heritage community to make the most of present and future technologies for the benefit of Jordanian society and economy. The goal is to foster convergence across multiple sectors and technologies, creating opportunities for cultural heritage professionals to engage with a variety of technologies from manuscript digitization to photogrammetry, LIDAR, and the Internet of Things and virtual reality (VR). The identification of existing available cultural heritage data and infrastructure, and their eventual enhancement, is the first step to positioning Jordan's cultural heritage community to contribute to this larger national vision.

The MaDiH (مديح) team believe the government policies noted above are having a positive effect on this goal, changing attitudes towards the identification, collection, and sharing of data and prompting enquiries about how institutions and individuals should best digitise their analogue archives. This supports Ottoum's 2015 research on technology policy in Jordan, which claimed that social and administrative policies have a demonstrable effect on the pace of national digital transformations.[123]

Amman
Photo by Mohammad Almashni on Unsplash

[122] Ministry of Information Technology and Communications, *REACH2025: From vision to action: Roadmap to excellence* (MoICT, 2016) https://jordankmportal.com/resources/reach2025-dot-vision-and-action-paper-long-version-final-07-dot-11-dot-2016-1.
[123] Ottoum, Issa SI., "Launching E-Government in Jordan" *World of Computer Science & Information Technology Journal* 5, no. 4 (2015).

OPEN DATA

Jordan's *Fourth National Action Plan 2018 - 2020 under the Open Government Partnership Initiative (OGP)* (2018) commits to a range of measures that will contribute to the development of DCH in Jordan, but especially the development and enhancement of open data. This commitment specifically aims to increase the amount of government data published, and its accuracy. This can be expected to include cultural heritage content related to datasets contained in the MaDiH (مديح) CKAN catalogue; for example, the MEGA-Jordan database is already (partly) open access. Developing an open access landscape in Jordan will require investment in DCH, in order to ensure the quality and accessibility of published data in a sector of central cultural and economic importance:

> The commitment seeks to promote the legislative and practical basis for improving the dissemination of governmental open data in Jordan, through issuing binding instructions for institutions to publish their datasets and develop tools to measure their quality. It also raises awareness of the importance of disseminating governmental open data, and encourages the adherence to publishing datasets as an evaluation requirement for King Abdullah II Excellence Awards.[124]

The policy is supported by the Open Government Data License (2019) and the Open Government Data Policy (2017) that provide legal definition for open data, and guidance to government officials about the principles and processes for making government data open. Because digital content on cultural heritage is economically important, familiar, accessible and full of potential access to it will facilitate connections across many institutions, individuals, and sectors both locally and internationally. Ensuring that data is high quality, appropriately licensed, and accessible is of significant national importance. The Jordan Open Source Association (JOSA), a MaDiH project partner, is closely involved in these initiatives. Its awareness of DCH requirements and opportunities, as well as all of government requirements and opportunities, positions it well to contribute.

[124] Ministry of Planning and International Cooperation, *The Fourth National Action Plan 2018 - 2020 under the Open Government Partnership Initiative (OGP)*. Amman (2018): 27.

CHALLENGES	• Encouraging tools and methods that ease the development of open databases. • Raising awareness among governmental entities involved in cultural heritage about standards for preparing datasets and the importance of publishing open data and setting appropriately ambitious timelines for implementation. • Issuing instructions for research and cultural heritage institutions and other relevant organisations to publish their open datasets through designated platforms after consultation with relevant stakeholders. • Increasing research funding related to the development and maintenance of cultural heritage data. • Encouraging the use of common standards in research projects to improve data sharing, reuse, and discovery.
RECOMMENDATIONS	• Use existing government open data policies to drive DCH. • Use existing government open data policies to build connections between commercial and public DCH initiatives. • Increase collaboration between Jordanian and international research funding agencies.

Qasr Bashir
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DATA ANALYSIS

PURPOSE AND SCOPE

The intention in this policy white paper is to provide a high-level overview of the project's findings, and align them to wider issues related to DCH in Jordan. Please refer to the full data analysis for detailed methodology and results.[125]

Before drawing conclusions based on our data, it is important to consider the following potential biases:

- Data identified outside Jordan (especially datasets) were biased towards online (and therefore digital) sources while data identified in Jordan involved visits to archives/museums/etc as well as online searching.

- Team members tasked with identifying data have backgrounds in archaeology (humanities side) and architecture. We remained conscious of this throughout the data collection process, but assume it had an effect on the type of datasets that were found (e.g. through existing networks and knowledge of keywords).

It is vital to recognise that the goal of the MaDiH (مديح) project was to begin the long process of identifying and cataloguing - in preparation for their active and varied use - datasets related to Jordanian cultural heritage *but it was only possible to make a start*. We believe the following data analysis, and especially the more detailed analysis,[126] provides a useful and in many ways actionable snapshot of the 'data landscape', but many questions remain. Primarily, it is by no means clear:

- What proportion of in-scope datasets have been identified (MaDiH (مديح) might reflect 90% of the available datasets, or 10%).
- The depth and dimensionality of the data (the datasets identified by MaDiH (مديح) might contain 100,000 items of content and information or 10 million, and reference 50 or 500 metadata fields).

[125] Pascal Flohr et al. "Mapping Digital Heritage in Jordan (MaDiH): What are the data telling us? (in preparation, 2021). See also the data in the MaDiH CKAN.
[126] Pascal Flohr et al. "Mapping Digital Heritage in Jordan (MaDiH): What are the data telling us? (in preparation, 2021).

DATA COLLECTION

Information was gathered about datasets on Jordanian cultural heritage. The geographical area was limited by the current political boundaries of the Hashemite Kingdom of Jordan. A broad definition of 'cultural heritage' was taken, following UNESCO, and both tangible and intangible (or physical and non-physical) heritage were included.[127] MaDiH did not collect natural heritage datasets, although in some cases natural heritage was present in a cultural heritage dataset.

Information about the existence and content of datasets was sought through: online searches, especially of existing repositories, library catalogues, and museum catalogues; in-person visits to museums and institutions, especially in, but not limited to, Jordan; physical and digital publications; and word of mouth, for example through our contacts, at the MaDiH workshops, and at conferences.[128] Also due to the limited time period available for collection, the objective was not to be comprehensive, but rather to gather a representative sample of datasets on Jordanian cultural heritage and test the proof of concept cataloguing platform and methods. However, it should be noted that, both following the project's aims and from a pragmatic point of view, the highest priority was given to digital online datasets, followed by digital offline datasets, with the lowest priority given to analogue datasets.[129]

The information on the datasets was entered into a customised CKAN metadata catalogue, set up and refined by King's Digital Lab according to the project requirements. CKAN is open, free source, data portal software (www.ckan.org) that has been adapted for recording other humanities datasets by King's Digital Lab (data.kdl.ac.uk).[130] Due to the limited development budget of MaDiH (مديح) during this reconnaissance stage, limited customisation was undertaken.

[127] See the 'Cultural heritage definition' section in this paper; J. Jokilehto/ICCROM Working Group Heritage and Society. "Definitions of cultural heritage: references to documents in history", (2005). http://cif.icomos.org/pdf_docs/Documents%20on%20line/Heritage%20definitions.pdf
[128] Esposito et al. "MaDiH (مديح) Mapping the Digital Cultural Heritage in Jordan Project. Datasets Identification and Publication Protocol", Zenodo (2020), p. 4. 10.5281/zenodo.4146756
[129] Ibid., page 4-5.
[130] See Arianna Ciula, "Exposing legacy project datasets in Digital Humanities: King's Digital Lab experience", Open Knowledge Foundation blog, July 22 2020, accessed January 19, 2021, https://blog.okfn.org/2020/07/22/exposing-legacy-project-datasets-in-digital-humanities-kings-digital-lab-experience/.

DATASET CHARACTERISTICS

'Organisation'

In the CKAN repository data model, an 'organisation' is the primary conceptual container datasets must be assigned to. Each dataset is held/maintained by one or more organisations, and each organisation typically owns/maintains multiple, often many datasets. In total, 188 distinct organisations were recorded by the MaDiH project, 46 inside and 142 outside Jordan. It is worth noting that some 'organisations' can in turn be part of other organisations, such as research projects or research centres that are present in universities. Partly as a consequence, universities are the most common type of organisation (26%), followed by research projects (12%) and research centres/institutes (11%). Museums are also well represented (11%).

Because most datasets that we recorded are held outside of Jordan, most organisations are also outside of Jordan, especially research-focused organisations (also a consequence of the 'outside' Jordan world containing many more research organisations, of course). Official (governmental) institutions are more common inside Jordan, reflecting the fact that these are in charge of its archaeology and heritage.

Temporal aspects

In the MaDiH (مديح) CKAN catalogue both 'archaeology' / 'athar' (dating to before 1750 CE) and 'heritage' / 'turath' (dating to 1750 CE) are represented. Almost half (45%) of the datasets record only post-1750 'heritage', 38% record pre-1750 'archaeology', and the remainder (17%) record both. Given the pre-1750-time range is much longer, and heritage specialists and policy makers are inclined to emphasise and protect archaeology rather than more recent heritage, this is interesting. As Fig. 1 shows, each of the major archaeological periods are also well represented.

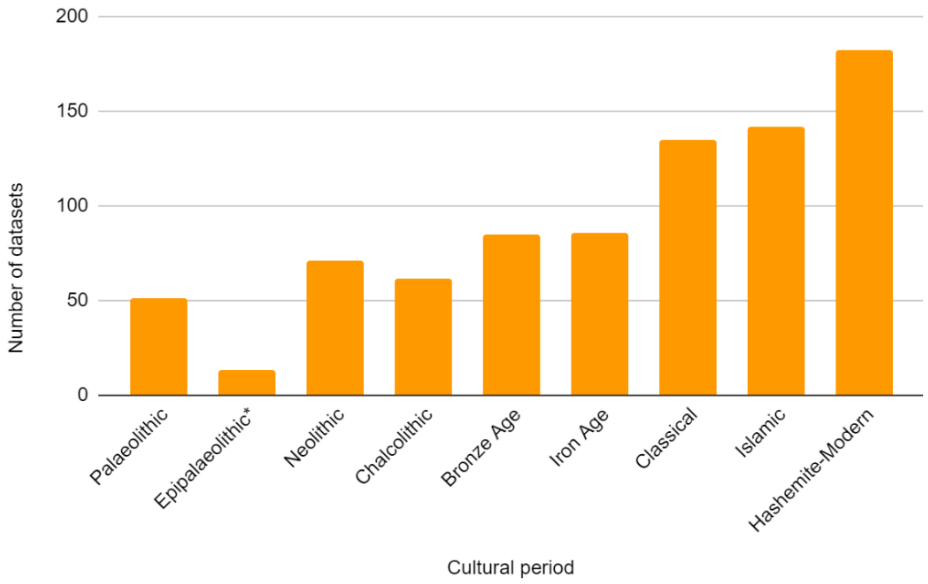


Figure 1. Major cultural periods represented in the datasets (number of datasets for each cultural period). The Epipalaeolithic is probably underrepresented as it was often not 'tagged' for multi-period datasets. Note that a dataset can, and often does, contain information on multiple periods.

Tangible and intangible heritage

The majority of the datasets are on tangible heritage (82%) but intangible heritage is described in a sizable portion (40%).[131] Most of the tangible heritage data is on immovable heritage (76%), like archaeological sites (52% of the total datasets), but movable heritage, such as collection objects, is also represented (34%).

Geographic spread

Even though archaeological research has traditionally focused on North and Central Jordan, and the largest modern cities since most of the arable land is present in the North(west), the area the datasets are describing is almost equally divided between North, Central, and South Jordan, with datasets in the South being marginally more common.

[131] Note that a dataset can include information on both tangible and intangible heritage.

Data types and formats

Fig. 2 shows that the majority (67%) of datasets are of, or contain, a text data type, followed by images (61%), databases (31%), and tabular data (13%). All the categories were based on their technical type, and contain a mixture of data depicting/describing heritage and data that is heritage itself, typically from the 19th-20th century age (e.g. modern photos of heritage as well as old photos).

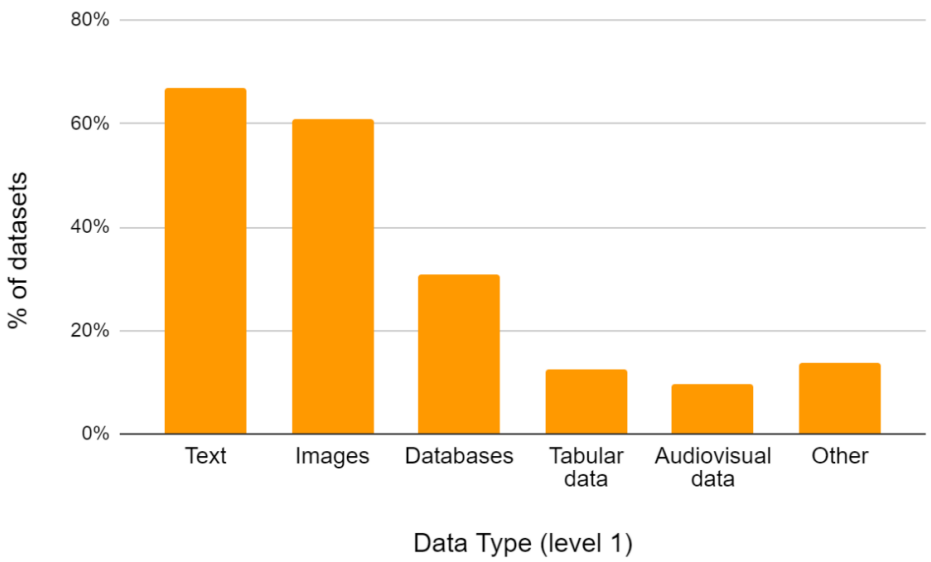


Figure 2. Percentage of datasets containing each of the major data type categories.

The text category is broad, ranging from published resources such as books (in 18% of the total datasets), articles (15%), and periodicals (6%) to more typically 'unpublished' or online only resources such as reports (16%) or texts published on the web (28%). Most of the text data type datasets consist of text *describing* heritage, with only a small minority actually being heritage itself. The most common image category is that of "photographs" (in 53% of the total of datasets), containing both recent photos of heritage and 'old' photographs. The datasets can be specific photograph archives (e.g. the Department of Antiquities Photo Archive or the ACOR Photo Archive) but in most cases the photos are present in combination with, for example, text data types such as in journal articles or on web pages.

The large majority (93%) of the datasets are digital, with only 7% of them available only in analogue form. This result is very likely to be biased by our online focus (see above), but it is also a reflection of the fact that the practice of digitally recording project data has been standard for decades (even if the initial field recording might have been on paper forms). In addition, there are digitization projects like the ACOR photo archive,[132] or the Albright Institute Map Collection,[133] which skewed the representation of digital vs analogue.

Accessibility

The majority of the datasets we recorded are available online (73%). Related to this, the majority of them are public (47%) or partially public (30%). It is likely that our data collection was affected by the fact that these datasets are more visible and easier to find. The fact that 93% of the datasets that we recorded are digital, even though not all of these are available online, is promising for making the data more accessible in future, however, as it means the data will have already been digitized.

Dataset location

The current location of the dataset is key information to our project, especially if the dataset is held inside or outside Jordan. The majority (65%) of datasets that we recorded are located outside Jordan, with a considerable minority of 35% curated from within Jordan. Of the datasets outside Jordan, the majority are held in Europe (34%), especially in the United Kingdom (11% of the total datasets), Germany (6%), the Netherlands (4%), and France (4%). Most of the rest of the datasets are held in the USA (22%), with only 4% held in the Middle East and 5% in other parts of the world (Fig. 3).

[132] "ACOR Photo Archive", American Centre of Research (ACOR), accessed April 28, 2020. https://photoarchive.acorjordan.org/about-our-collections/; See also the MaDiH CKAN entry: https://madih-data.kdl.kcl.ac.uk/dataset/the-american-center-of-oriental-research-photo-archive

[133] "Albright Institute Map Collection", W.F. Albright Institute of Archaeological Research, accessed March 23, 2020. https://aiar.org/library/map-collection/; see also the MaDiH CKAN entry: https://madih-data.kdl.kcl.ac.uk/dataset/albright-institute-map-collection

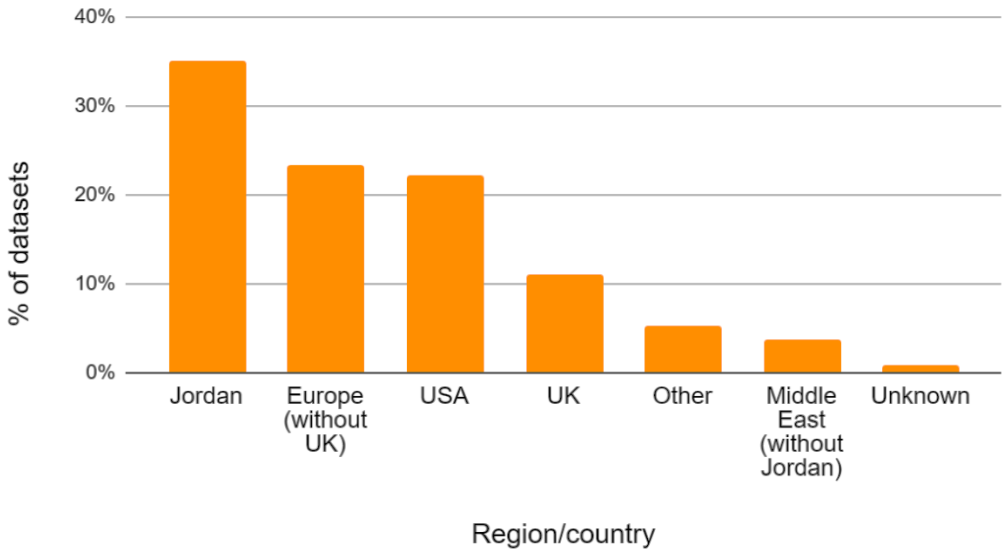
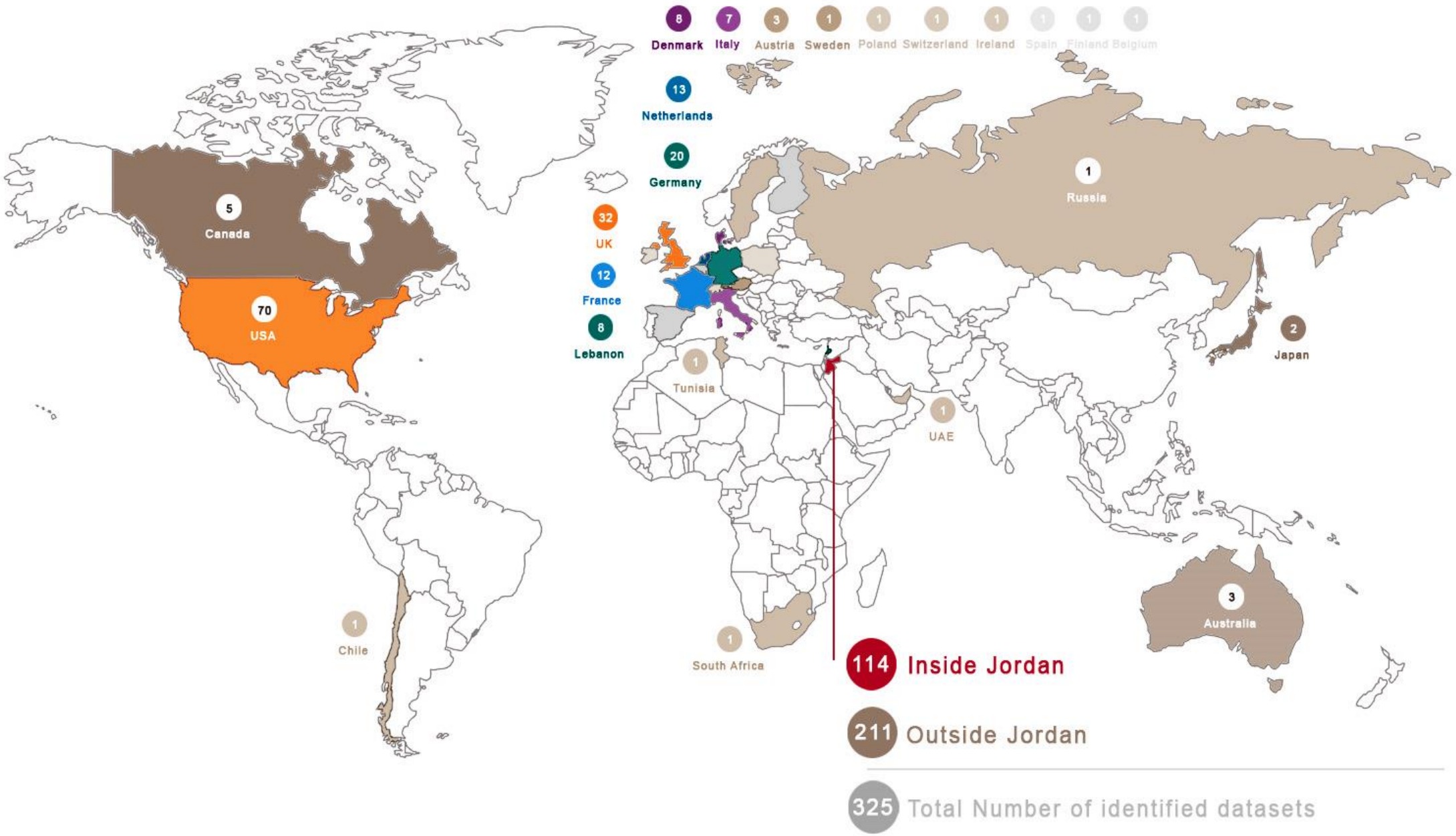


Figure 3. Dataset (maintainer) location.

The ratio between recorded datasets held within and outside of Jordan partly reflects reality, but it is probably at least partly affected by 1) a difference in digital and online availability and 2) different recording strategies inside and outside Jordan. Outside Jordan we relied more on online, digital and/or published datasets, while inside Jordan information about datasets was much more frequently gained through in-person meetings, emails, phone conversations, public lectures, and social media. This is reflected, for example, in the percentage of online datasets, which is 53% for the datasets in Jordan and 83-100% for the datasets held outside Jordan. Nonetheless, this is probably also partly a reflection of reality: many foreign archaeological and cultural heritage projects take place in Jordan, and the datasets broadly correspond to the nationalities we would expect to see. It also reflects the presence of research institutes from those countries in Jordan (ACOR for the USA, Ifpo for France, GPIA for Germany, the CBRL for the UK) while for other countries these institutes are absent. Nonetheless, key information is kept in Jordan, such as archaeological site information, where each archaeological mission is required to submit a report to the DoA that is archived by its Studies and Publications directorate (the DoA Reports Archive), and archaeological site information is entered into MEGA-Jordan.

There are clear differences in the datasets that we recorded based on whether they are held within and outside Jordan. Within Jordan there is a much greater focus on the period after 1750 CE, i.e. 'heritage' (turath), and especially on the 20th century (Late Ottoman, Hashemite, and modern periods), while outside Jordan there is more of a focus on pre-1750 'archaeology'. In addition, and partly related to the above, there is more of a focus on intangible heritage inside Jordan.


8 Denmark
7 Italy
3 Austria
1 Sweden
1 Poland
1 Switzerland
1 Ireland
1 Spain
1 Finland
1 Belgium
13 Netherlands
20 Germany
32 UK
12 France
8 Lebanon
5 Canada
70 USA
1 Chile
1 Tunisia
1 South Africa
1 Russia
2 Japan
1 UAE
3 Australia
114 Inside Jordan
211 Outside Jordan
325 Total Number of identified datasets

SUSTAINABILITY

Because of the high proportion of datasets held outside Jordan, especially in universities, we might assume that the data is well maintained and likely to remain available for the foreseeable future. It is difficult to ascertain without further detailed research but this is a positive aspect of the MaDiH (مديح) project. On the whole, however, it needs to be recognised that the lack of an overall strategy for the identification, aggregation, and management of Jordanian DCH (and associated funding to ensure sustainability) is of concern. Without a focused national initiative and long-term funding, it is likely that many of the datasets identified by the project will become unavailable over time. That is especially the case for content hosted via ad hoc front-end interfaces / websites without a robust data or content management solution in the back-end.

If the MaDiH (مديح) catalogue, or a version of it, was made available for data upload by interested parties (i.e. as a repository) this would mitigate that problem to a significant degree. It would need to be properly managed, with review and approval mechanisms (and first and foremost a data management plan), but such an approach was often suggested to the MaDiH team and we believe it would be well used by the community. In general, a greater focus on data sovereignty - active identification and management of national DCH data - is likely to increase sustainability by focussing attention on the value and potential of Jordanian DCH data.

CHALLENGES	• Increased awareness of data sovereignty could have a positive effect on data sustainability. • A dependence on short-term funding is undermining data sustainability. • Long-term funding and permanent staff would be needed to keep any national repository up to date.
RECOMMENDATIONS	• Develop a national centre for Jordanian DCH, with the MaDiH (مديح) catalogue/repository as the first primary asset. • Consider a major investment to rationalise and sustain national DCH assets, on a triage basis. • Use MaDiH (مديح) as the basis for a national DCH repository, supported by long-term funding. • Conduct additional user research to support the case for investing in a national DCH data catalogue.

MULTILINGUALISM

The MaDiH (مديح) project has worked to provide a bi-lingual (Arabic - English) project environment, and bi-lingual technical, communications, and documentation outputs where possible, to facilitate engagement with as broad a community as possible (academic researchers but also heritage professionals, CKAN developers, students, and indeed the general public). These efforts have been successful, but only represent the start of a longer process that is needed to deeply embed multilingualism in Jordanian DCH, at a cultural but also technical level. The impact of the MaDiH catalogue would be tremendously increased by having both the CKAN user interface and the metadata model translated to Arabic, for example.[134] Although CKAN does currently provide a core translation in Arabic, the quality of this translation is quite low. There are opportunities to partner with the CKAN open source team to improve the Arabic translations in the product over the medium to long-term. This would put Jordanian DCH professionals at the heart of a significant global open source project.

[134] Refer to the MaDiH (مديح) Technical White Paper for more information about the data model.

The impact of a professional technical translation of the MaDiH data model, even in its current form, would also facilitate greater engagement from researchers and students, not only in Jordan, but also in the Arabic-speaking world. Furthermore, the data model could be reused (and implemented) by Arabic-speaking teams or international teams interested in either creating Digital Humanities (DH) products catered to the Arab world or offering Arabic as a default language for their databases, especially when collecting data from Arabic-speaking countries. At the time of writing a state of the internet language report is being produced by the Centre for Internet & Society and the Oxford Internet Institute, through the *Whose Knowledge?* Project.[135] However, we are already aware, for example, that most *Wikipedia* articles about local places are in English and this is also the case for Jordan[136] and that more effort in DH is needed to create and support multi/bilingual-enabled digital knowledge infrastructure.

The language of the dataset (and its data) is also important for how understandable and therefore how accessible the dataset is. Multi-language datasets are understandable to more people than single language datasets, those in English are understandable to most of the academic community, while those in Arabic are understandable to essentially every Jordanian. As shown in fig. 4, English is the most common language of datasets recorded in the MaDiH catalogue (71% of datasets), followed by Arabic (36%), with datasets that are only available in other languages are a small minority.[137] This of course partly represents the fact that we could not read these datasets and were unlikely to find them in our search, but it is very likely also a true representation of the languages in which datasets on Jordanian heritage are recorded.

Only 11% of the datasets are available in both English and Arabic (and not necessarily all of the data was available fully in both languages), restricting access to and use of the data in the same datasets by both the international research community and non-academic Jordanians. This reflects the fact that many people consider English to be the lingua franca of the international research community, but it is worth remembering a 'monolingual mindset' negatively affects the use of languages using non-Latin scripts like Arabic, and impoverishes the scholarly landscape which thrives on multiple

[135] Anasuya Sengupta, "Decolonising the Internet's Languages... and questions of epistemic (in)justice, Disrupting Digital Monolingualism Online Workshop" 16th-17th June 2020, accessed August 5, 2020, https://www.youtube.com/watch?v=jOEyB-2Hc0I&feature=youtu.be.
[136] Martin Dittus and Mark Graham, "Mapping Wikipedia's Geolinguistic Contours", *Digital Culture & Society* 5, no. 1, (2019): 147-164.
[137] This is the language of the data in the datasets.

perspectives:[138] a focus on and commitment to bi-lingualism in Jordanian DCH is crucial. This aligns to UNESCO's 2003 Recommendation Concerning the Promotion and Use of Multilingualism and Universal Access to Cyberspace,[139] specifically Jordan's assertion that "the development of multilingual content and systems might safeguard tangible and intangible cultural heritage as well as share cultural heritage products worldwide" (Point 9) in an associated report.[140]

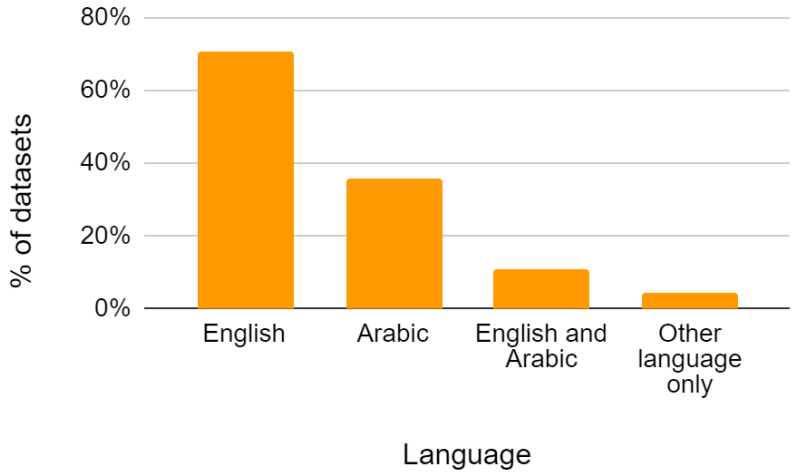


Figure 4. Dataset language, in percentage of the total datasets (based on MaDiH CKAN).

Multi-lingual datasets are often the results of large aggregations project, most notably, the UNESCO World Heritage List[141] available in Arabic, English, Dutch, French, Japanese, and Spanish; the World Digital Library[142] available in Arabic, English, Chinese, French, Polish, Russian, and Spanish, and the Museum with No Frontiers Database[143] available in Arabic, English, French, and Spanish.

[138] Spence, "Introduction, Disrupting Digital Monolingualism Online Workshop 16th-17th June 2020", Wagner, "Challenging research infrastructures from a multilingual DH point of view, Disrupting Digital Monolingualism Online Workshop 16th-17th June 2020".
[139] UNESCO, "Recommendation Concerning the Promotion and Use of Multilingualism and Universal Access to Cyberspace" (UNESCO, 2003).
[140] UNESCO, "Second Consolidated Report on the Measures Taken by Member States for the Implementation of the Recommendation Concerning the Promotion and Use of Multilingualism and Universal Access to Cyberspace" (UNESCO, 19 July 2011).
[141] "UNESCO - World Heritage List", Mapping Digital Heritage in Jordan (MaDiH) project, accessed January 19, 2021, https://madih-data.kdl.kcl.ac.uk/dataset/unesco-world-heritage-list.
[142] "The World Digital Library (WDL)", Mapping Digital Heritage in Jordan (MaDiH) project, accessed January 19, 2021, https://madih-data.kdl.kcl.ac.uk/dataset/the-world-digital-library-wdl.
[143] "Museum With No Frontiers (MWNF) Database", Mapping Digital Heritage in Jordan (MaDiH) project, accessed January 19, 2021, https://madih-data.kdl.kcl.ac.uk/dataset/mwnf-database.

CHALLENGES	• Significant opportunities exist for Jordan DCH to enhance local and global digital multilingualism.
RECOMMENDATIONS	• Stimulate the creation and development of suitable Arabic language and relevant digital platforms and content that is accessible online throughout the Arabic speaking region. • Translate the MaDiH catalogue and data model into Arabic. • Jordanians involved in DCH should be encouraged to take a leadership role in the enhancement of global digital multilingualism, by labelling geodata in projects such as WikiData, and contributing to projects such as Wikipedia.

Ad-Deir, Petra
(CC BY-NC-SA), Pascal Flohr

LICENSING AND INTELLECTUAL PROPERTY

The Jordan National Information and Communications Technology (ICT) Strategy (2019-2021)[144] provides broad ICT strategy guidance for the country, and recommends the launch of initiatives and training that raise the awareness of companies or individuals to promote intellectual property development and registration. This policy is supported by the cross-sector *General Policy for the Information & Communications Technology and Postal Sectors* (2018), noting that "as in the IT sector, other sectors of the economy can and should benefit from the opportunities and the prospect of developing intellectual property assets from the application of new IT technologies".[145] This can be achieved through the MaDiH (مديح) project by promoting best practice in research information management, and publicising the range of options available to content producers and entrepreneurs to license their outputs (be they articles, blog posts, code, or datasets).

Datasets and metadata listed in the MaDiH (مديح) CKAN catalogue suggest that the Jordanian DCH community would benefit from education and information related to data licensing and its relationship to intellectual property. A decision was made to apply a Creative Commons Attribution 4.0 Generic NonCommercial (CC BY-NC 4.0) license147 to the metadata entered into the catalogue by the MaDiH (مديح) team, and many of the listed datasets had either similar licenses or clearly set out customised Terms of Use. However, a number of the listed datasets chose not to apply any kind of license. In many cases intellectual ownership will be implied by the university that held the research grant that funded a research project, or by the owner of the website content is delivered through, but this is less than ideal because it offers potential users of the data no clear information about who the owner is and whether the content owner is happy for them to use the data and in what ways.

The MaDiH (مديح) CC BY-NC 4.0 license, however, states that users can "Share — copy and redistribute the material in any medium or format" and "Adapt — remix, transform,

[144] Ministry of Information and Communications Technology, *Jordan National Information and Communications Technology (ICT) Strategy (2019-2021)*, Amman: 2018.
[145] Ministry of Information and Communications Technology, *General Policy for the Information & Communications Technology and Postal Sectors*, Amman, 2018.

and build upon the material", except for commercial purposes,[146] as long as the MaDiH (مديح) project is attributed to any final product. The more people understand these kinds of issues, and learn to apply an appropriate license to their content or data, the more the quality and value of repositories such as MaDiH (مديح) would be increased significantly.[147]

The goal should be to facilitate the adoption of FAIR data principles, across as wide a range of research and government stakeholders as possible. FAIR (Findable, Accessible, Interoperable, Reusable) principles have been adopted internationally to ensure research and cultural heritage data is optimised for maximum use and reuse, and in particular to facilitate the development of open science (see above). This cannot be achieved without applying clear licenses to data.[148]

CHALLENGES	• The Jordanian DCH community would benefit from education and information related to data licensing and its relationship to intellectual property. • Intellectual ownership of datasets will often default to the university holding research funding for the project, rather than a more appropriate local entity.
RECOMMENDATIONS	• Undertake a more detailed assessment of licensing of Jordanian DCH datasets and development national guidelines for the assertion of intellectual data rights. • Publicise FAIR data principles, and their relationship to open science and open access publishing.

[146] MaDiH is open to especially Jordanian commercial companies subscribing to its values; please contact the project if you would like to use the (meta)data commercially.
[147] Simone Aliprandi, *Creative Commons: A User Guide* (Milano: Ledizioni, 2014), http://books.openedition.org/ledizioni/199.
[148] Peter McQuilton et al., "FAIRsharing Collaboration with DataCite and Publishers: Data Repository Selection, Criteria That Matter", 19 October 2019, https://doi.org/10.17605/OSF.IO/N9QJ7; Mark D. Wilkinson et al., "The FAIR Guiding Principles for Scientific Data Management and Stewardship", Scientific Data 3, no. 1, 15 March 2016m 160018, https://doi.org/10.1038/sdata.2016.18.

DIGITAL CULTURAL HERITAGE OPPORTUNITIES

Opportunities to build on the work completed by the MaDiH (مديح) project are wide-ranging. At the time of writing the goal is to migrate the CKAN catalogue to Jordan from King's College London, to ensure data sovereignty and long-term sustainability and position it as a digital cultural heritage asset that can be both used as-is and form the basis of future development. The catalogue is currently close to the default 'out of the box' CKAN state (see the MaDiH (مديح) Technical White Paper) but uses technology that could be scaled with additional investment to become a major national asset.

The MaDiH (مديح) CKAN catalogue's primary benefit is as a central point to discover digital content related to Jordanian cultural heritage. It offers an opportunity for researchers and research teams to undertake landscape research in the preparation of their projects, identifying existing and related research and identifying the personal and institutional research networks that have underpinned archaeological and cultural heritage research within the geography of contemporary Jordan. Because the catalogue identifies content held outside as well as inside Jordan, opportunities exist for universities and government agencies to identify potential research partners and for funding agencies to identify research areas in need of further investment.

This relates to tangible but also intangible heritage, which is less commonly viewed as an asset capable of public or commercial development. Jordan also has a rich natural heritage, and future collaborations with relevant Ministries, institutes, and organisations such as the National Agricultural Research Centre (NARC) or the Royal Society for the Conservation of Nature (RSCN) would enable integration of documentation, outputs, and protection of both cultural and natural heritage. Opportunities to enhance tourist experiences with a combination of natural, and cultural tangible and intangible heritage and to strengthen discourse related to Jordanian national identity and multiculturalism are increasingly being taken, but especially for intangible heritage care needs to be exercised to take into account ethical aspects of this 'living heritage'.[149]

[149] Hani Hayajneh, "The legal protection of the intangible cultural heritage in the Hashemite Kingdom of Jordan", in *The legal protection of the intangible cultural heritage: a comparison*, ed. Pier Luigi Petrillo (Springer, 2019).

This would contribute to the development of what is referred to in international geo-political literature as 'soft power', strengthening Jordan's geo-political posture and contributing to UNESCO Sustainable Development Goals (SDGs).[150] The MaDiH catalogue could also be used as a starting point to identify material artefacts held in overseas institutions around the world, contributing to government analyses about the extent of those collections and informing policies related to international relationship management and in some cases repatriation of the objects to Jordan. A natural first step would be to produce a global map of Jordanian artefacts, to understand their geographic spread and begin an impact analysis capable of informing government policy.

Opportunities also exist in the commercial world, enabling tourism and the development of a local digital cultural heritage technology sector focused on enabling it. The rich cultural heritage of Jordan makes it comparable to Egypt in its capacity to provide compelling immersive experiences for audiences in Jordan and overseas, using Virtual Reality (VR) and other Extended Reality (XR) technologies and supporting high quality exhibitions about Jordan at flagship international institutions. The MaDiH (مديح) CKAN catalogue provides a glimpse of what might be possible with additional investment, positioning Jordan as a global leader in the production of DCH content to enhance the internal tourism sector but also contribute to international museums, online magazines, and multimedia educational products.[151] The use of digital assets could in this way contribute to the responsible and sustainable enjoyment and use of heritage. Wider educational opportunities are discussed below.

Some of these opportunities could be realised in the short term but the bolder initiatives would ideally be realised over a 10–20-year time horizon with significant investment from international and national funding sources. The MaDiH (مديح) CKAN catalogue, turned into a repository, could form the data 'landscape' to such an undertaking, perhaps positioned within a national DCH centre tasked with furthering this vision in collaboration with government, university, and commercial partners.

[150] Jan Melissen, *The New Public Diplomacy: Soft Power in International Relations* (London: Palgrave Macmillan, 2005).
[151] For example, the virtual 3D models listed in the MaDiH (مديح) CKAN repository from the fieldwork of researchers at the School of Archaeology, Geography and Environmental Science (SAGES) at the University of Reading, United Kingdom, https://madih-data.kdl.kcl.ac.uk/da_DK/dataset/wadi-faynan-collection-of-3d-models/resource/3c1449f8-218b-423c-8d98-6411439232e1.

مديح

CHALLENGES	• The MaDiH (مديح) CKAN repository is basic, but could be scaled to become a national asset.
RECOMMENDATIONS	• Ensure the MaDiH (مديح) CKAN catalogue is migrated to Jordan and maintained. • Explore the potential for the MaDiH (مديح) CKAN catalogue + repository to enable a national centre for digital cultural heritage. • Consider development of a global map of Jordanian artefacts. • Explore opportunities to use data identified by the MaDiH (مديح) project to enable cultural heritage, educational, and commercial outcomes.

Wadi Rum
Photo by Matteo Paonessa on Unsplash

EDUCATION, TRAINING & ONLINE LEARNING OPPORTUNITIES

Jordanian children are taught aspects of Jordanian cultural heritage from the ages of 12 to 18, through a broad range of disciplines: from history to Islamic education and Arabic language. The focus is on modern Jordan, with less emphasis on pre-1750 heritage. Content focuses on Jordan's built heritage, with no focus on intangible heritage and the way of life in local communities. Instruction also tends to focus on the past, rather than building connections for students between their contemporary experience and past civilisations that convey the multicultural nature of the country. It is important that as many educational resources are identified to assist in the education of Jordanian children as possible, to strengthen a sense of the "cultural and symbolic components" of national heritage that encourage people to value and care for their cultural heritage.[152]

Abu Jaber House, Al-Salt
(CC BY-NC-SA), Shatha Mubaideen

The MaDiH (مديح) catalogue is an important resource for teachers and government officials involved in the development of Jordan's school curriculums and could be used to source material for use in teaching. This includes basic content such as images and documents but also more technical items such as

[152] Hadi Tawalbeh, Mahmoud Al-Naamneh, Wassef Al Sekhaneh, and Wasif Hwari, "The Role of Cultural Heritage Resources Conservation in Educational Textbooks of Social and National

contemporary aerial photography and technical files that can be displayed in Geographic Information Systems (G.I.S.). In this way textbooks and supplementary material related to Jordanan cultural heritage can be produced (including the use of intangible heritage captured in audio and video recordings), but opportunities also exist to teach students computing, information technology and digital citizenship using digital cultural heritage content. This is important given much computer training is produced in a generic way without references to local culture and identity. The content could also be used to develop rich multimedia teaching experiences using learning management systems (LMS) such as Moodle, at secondary but also tertiary level. Online learning resources using content sourced from the MaDiH (مديح) catalogue could engage younger generations.

Opportunities broaden at tertiary level, extending from teaching about Jordan's cultural heritage to introductory instruction in Digital Humanities (DH) and Research Software Engineering (RSE). Introductory workshops could be designed for university students, in cooperation with their professors, to introduce MaDiH as a resource. Topics could explore the country's cultural heritage (for History or Architecture courses, for example), highlighting the educational value of museums or institutions and their collections. DH courses could introduce students to the fundamentals of repository design and management and the basics of project management, perhaps requiring them to design and build their own online resource using content in the MaDiH catalogue and a tool such as https://omeka.org/. In selecting and curating their content, they would not only learn about Jordanian cultural heritage but many skills relevant to contemporary professional life, from information management to project management. Students interested in pursuing a career in archival or library science could work with the network of heritage organisations related to MaDiH, that might be able to provide opportunities or internships for students to help them gain new knowledge and skills by contributing to ongoing archiving or digitization projects. Those interested in RSE could work with the Information Technology (IT) team maintaining the CKAN product, gain an understanding of the different kinds of datasets and appropriate international metadata standards and licenses,[153] and contribute to the international CKAN project. The project team has published the training material of the Research Software Engineering on DARIAH to encourage this kind of training.[154]

Education in Basic Stage in Jordan", *International Journal of Conservation Science* 10 (2019), p.682.

[153] See Licensing and Intellectual Property, above.
[154] "King's Digital Lab MaDiH's (مديح) RSE Training", European DARIAH-Campus, accessed January 19, 2021, https://campus.dariah.eu/resource/rse2019.

Professional development, or 'life-long learning' is also important.[155] As with all countries involved in intensive management of cultural heritage assets, Jordanian institutions require training to ensure best practice is followed in indexing, conservation, and digitization of their archives.[156] As these practices are often technology-dependent it is necessary to engage in continuous training, to keep up with new techniques as they appear. It is clear from many of the datasets collected by the MaDiH project that information management best practices are not widespread, especially outside major national institutions. This is to be expected but could be remedied through more widespread education in the basics of digital information management. The MaDiH catalogue and related training materials could also be an excellent resource for tourist and archaeological site guides.

Because it is aligned to Jordan's government open data policies, MaDiH (مديح) can also function as an educational tool to inform students and the general public about the nature and values of these policies. Awareness of the benefits of open-source programs such as the CKAN data management system product used for the MaDiH (مديح) catalogue is increasing in Jordan, but it is useful to have an example tailored to local needs and showcasing the considerable cultural heritage assets of the country. The Open Government Data Policy emphasises the value of accessibility (the ease with which information can be obtained), whether through physical or electronic means for all end users. The Jordanian government also encourages organisations to digitise their records, ranging from old budgets or minutes of meetings to photos and maps. MaDiH (مديح) provides a concrete example of the benefits of such activities, along with ensuring digitized content is stored in documented machine readable file formats that can be electronically processed (such as .csv and .xml) to decrease complexity, resource use, risk, and expense.

[155] World Bank, ed., *Lifelong Learning in the Global Knowledge Economy: Challenges for Developing Countries, Directions in Development* (Washington, DC: World Bank, 2003).
[156] Mariam Ababsa, *Jordan Documentary Heritage: Part 1*, (UNESCO Amman Office, 2014), http://www.unesco.org/new/fileadmin/MULTIMEDIA/FIELD/Amman/pdf/Jordan_Documentary_Heritage.pdf

CHALLENGES	• The MaDiH catalogue has considerable value for the Jordanian education system, to assist with teaching of cultural heritage and introductions to digital humanities and research software engineering.
RECOMMENDATIONS	• Ensure teachers, university lecturers, and government officials involved in curriculum development are aware of the MaDiH catalogue. • Produce example teaching content and/or a model LMS to demonstrate the educational value of MaDiH datasets. • Use the MaDiH (مديح) repository as an exemplar of open source technology, and to demonstrate the value of open access and open data policies, and best practices in information management.

APPENDIX A: KEY RECOMMENDATIONS

1. Increase Jordanian alignment to international DCH policies and standards.
2. Use the broad definition of 'cultural heritage' to ensure Jordan's DCH is protected.
3. Consider including natural heritage in the project in future and/or increasing integration of digital documentation and protection of cultural and natural heritage through collaboration with natural heritage-focused partners.
4. Use Jordan's deep experience in cultural heritage management and archaeology to become a global leader in DCH and DA.
5. Contribute Jordanian content to international initiatives such as ARIADNE Plus.
6. Build a cohort of Jordanian RSEs committed to the long-term development of DCH infrastructure, and the production of DCH products and services.
7. Foster technical ties between cultural heritage institutions, Jordanian government, commercial, and higher education sectors.
8. Jordan's expertise in Arabic - English translation could position it as a centre of excellence for digital multilingualism.
9. Jordan's expertise in Arabic - English translation could make it an attractive partner for technology companies and open source initiatives interested in 'localisation' of content.
10. Jordan has ratified international charters on tangible and intangible heritage, as well as natural heritage. Gaps in coverage should be identified and filled.
11. Increased collaboration between Ministries and Departments and other heritage organisations to link policy and to (digitally) connect data collection and storage between athar, turath, and intangible cultural heritage.
12. Continue the collation of archaeological sites in MEGA-Jordan; setting up of an online database for post-1750 heritage; expansion of making available online of the ICH database(s).
13. Integrate these databases, e.g. through Linked Open Data, at a single online access point.
14. Leverage the relatively high ratio of digital datasets identified by the MaDiH project, to aggregate content, develop products etc.
15. Build on Jordan's existing regional leadership in DCH.

16. Leverage Jordan's openness to and knowledge of DCH. and open access principles.
17. Use existing DCH infrastructure in Jordan as a foundation for data sovereignty.
18. Align government digital strategy with emerging research infrastructures and cross-disciplinary Open Science.
19. Use the experience in DCH evidenced in the MaDiH CKAN catalogue to contribute to wider national efforts to increase capacity in RI and Open Science.
20. Integration of DCH in national RI policies and roadmaps.
21. Improve recruitment and retention of high skilled RSEs.
22. Improve the quality of computational methods and open science.
23. Improve the sustainability of research software and infrastructure.
24. Build connections with the international RSE community.
25. Encourage funding agencies to offer funding for RSE fellowships, apprenticeships, and internships based in Jordan and abroad
26. Use existing government open data policies to drive DCH.
27. Use existing government open data policies to build connections between commercial and public DCH initiatives.
28. Increase collaboration between Jordanian and international research funding agencies.
29. Develop a national centre for Jordanian DCH, with the MaDiH (مديح) catalogue/repository as the first primary asset.
30. Consider a major investment to rationalise and sustain national DCH assets, on a triage basis.
31. Use MaDiH (مديح) as the basis for a national DCH repository, supported by long-term funding.
32. Conduct additional user research to support the case for investing in a national DCH data catalogue.
33. Stimulate the creation and development of suitable Arabic language and relevant digital platforms and content that is accessible online throughout the Arabic speaking region.

34. Translate the MaDiH catalogue and data model into Arabic.

35. Jordanians involved in DCH should be encouraged to take a leadership role in the enhancement of global digital multilingualism, by labelling geodata in projects such as WikiData, and contributing to projects such as Wikipedia.

36. Undertake a more detailed assessment of licensing of Jordanian DCH datasets and development national guidelines for the assertion of intellectual data rights.

37. Publicise FAIR data principles, and their relationship to open science and open access publishing.

38. Ensure the MaDiH (مديح) CKAN catalogue is migrated to Jordan and maintained.

39. Explore the potential for the MaDiH (مديح) CKAN catalogue + repository to enable a national centre for digital cultural heritage.

40. Consider development of a global map of Jordanian artefacts.

41. Explore opportunities to use data identified by the MaDiH (مديح) project to enable cultural heritage, educational, and commercial outcomes.

42. Ensure teachers, university lecturers, and government officials involved in curriculum development are aware of the MaDiH catalogue.

43. Produce example teaching content and/or a model LMS to demonstrate the educational value of MaDiH datasets.

44. Use the MaDiH (مديح) repository as an exemplar of open source technology, and to demonstrate the value of open access and open data policies, and best practices in information management.

APPENDIX B: ACRONYMS

- Alliance of Digital Humanities Organizations (ADHO).
- American Center of Research (ACOR).
- UK Archaeological Data Service (ADS).
- Council for British Research in the Levant (CBRL).
- Comprehensive Knowledge Archive Network (CKAN).
- Digital Archaeology (DA).
- Digital Cultural Heritage (DCH).
- Digital Humanities (DH).
- Department of Antiquities (DoA).
- Documentation of the Objects in Jordanian Archaeological Museums (DOJAM).
- Endangered Archaeology in the Middle East and North Africa (EAMENA) project.
- European Research Infrastructure Consortium (ERIC).
- Findable, Accessible, Interoperable, and Reusable (FAIR) principles.
- Greater Amman Municipality (GAM).
- Gross Domestic Product (GDP).
- Geographic Information System(s) (GIS).
- Galleries, Libraries, Archives and Museums (GLAM) sector.
- Global Outlook::Digital Humanities (GO:DH).
- German Protestant Institute (GPIA).
- Information and Communication Technology (ICT).
- Information Technology (IT).
- Hashemite University (HU).
- Intangible Cultural Heritage (ICH).
- International Council on Sites and Monuments (ICOMOS).
- International Organization for Standardization (ISO).
- The Jordan Antiquities Database and Information System (JADIS).
- Jordan Open Source Association (JOSA).
- King’s College London (KCL).
- King’s Digital Lab (KDL).
- Light Detection and Ranging (LIDAR).

- Learning Management System (LMS).
- The Middle Eastern Geodatabase for Antiquities (MEGA / MEGA-Jordan).
- Ministry of Digital Economy and Entrepreneurship (MoDEE) in Jordan.
- Ministry of Tourism and Antiquities (MoTA) in Jordan.
- Non-Latin Script(s) (NLS).
- Optional Character Recognition (OCR).
- Research and Development (R&D).
- Research Data Alliance (RDA).
- Research Data Management (RDM).
- Research Infrastructures (RI).
- Research Software Engineering (RSE).
- Special Interest Group (SIG).
- UK Research & Innovation (UKRI).
- Virtual Reality (VR).

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