



Impact of COVID-19 on Archaeology and Cultural Heritage

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About this document

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1 Introduction and overview

This report presents the results of an ARIADNEplus study on the impacts of the COVID-19 crisis on the sectors of archaeology and cultural heritage. The study was carried out to understand the consequences for these sectors and how ARIADNEplus could contribute to recovery, beneficial changes in practices, and future resilience. ARIADNEplus focuses on uses of digital technologies for archaeology and cultural heritage and this is also the main theme of the study results.

The study describes impacts on academic as well as contract archaeology and cultural heritage institutions and professionals. The cultural heritage sector has overall suffered more from the impact of the COVID-19 crisis but benefitted significantly from using available online platforms to stay connected with audiences and offer cultural content and experiences.

Concerning archaeology, the study addresses suggested changes in research methods, how work on collection databases continued during the crisis, and the role of repositories for data access and reuse. Furthermore, it includes a spotlight on how the COVID-19 crisis raised awareness of the FAIR data agenda. The study suggests that the overall message to be drawn from the impacts of the COVID-19 crisis is “no return to business as usual”, instead progress in Open Science practices should be promoted.

The final chapter summarises the study results and gives recommendations for activities ARIADNEplus might support, what the project can offer, perceived beneficial changes in archaeological research and cultural heritage communication.

The COVID-19 crisis arguably will increase the effect of the work of ARIADNEplus for proper data management and sharing, digital repositories, and data discovery, access and use for archaeological research. Research funders, councils and associations take the sharing of knowledge and data demonstrated during the COVID-19 pandemic as an example of Open Science which they now want to see adopted in all fields of research.

More researchers in other fields also recognised that digital repositories, data search and access services, and virtual research environments are important for their work, including archaeologists. For example, in the ARIADNEplus repository survey of 27 repositories that could collect and analyse access to their data 24 said that during the COVID-19 pandemic overall there was an increase in use from 5% to over 100% (ARIADNEplus 2021: 45-46).

There is no guarantee that effects of the COVID-19 crisis will persist, meanwhile ARIADNEplus will continue to promote and possibly increase what the project can offer the archaeological research and data management community for adopting Open Science and FAIR data principles.

2 Academic archaeology

The COVID-19 crisis has a strong impact on archaeological research activities. In 2020 and 2021 fieldwork campaigns of university-based and other projects were cancelled or curtailed, shutdown of institutes and travel restrictions meant that researchers had difficulty accessing laboratories, reference collections and archival materials.

Fieldwork campaigns and field schools with students and volunteers following COVID-19 regulations for travel, accommodation and work protocols (e.g., physical distancing, no shared use of equipment, etc.) were hardly possible, and therefore cancelled by the organisers responsible for the participants' health and safety. The same happened with Public Archaeology activities at archaeological sites.

Where field schools were cancelled alternative activities with students included work on previously generated data and presentation of results. For example, at Leiden University an existing exhibition on Caribbean archaeology was turned into a website presenting results from many excavations in the region (Leiden University 2021).

In Public Archaeology, organisations and projects provided resources for online teaching and learning, activities such as webinars and online reading groups, online desk research and back garden digs, and other ways to stay active until a return to other participation and volunteering is possible (Band 2020; Fox 2020; Redfern 2020).

With the field seasons in 2020, and in many cases also 2021, cancelled, archaeologists had more time to analyse the data of past seasons and prepare publications. Where ground-truthing assumptions with fieldwork data was not possible, an approach was the digitising and repurposing of existing legacy data, e.g. to confirm assumptions based on remote-sensing imagery (Fitton & Wynne-Jones 2021). Archaeologists also explored new tools for improving the digital documentation workflow and related skills to be best prepared for future field seasons (Budka 2020).

Academic archaeologists active on missions in developing countries longing to get back to site may have to wait some time until this will be feasible. It will take some time until some countries will see much of their populations vaccinated, and measures against COVID-19, which make work difficult will remain in place. Meanwhile they could reconsider their relations with local communities and researchers as projects are often perceived as not being conducted on equal terms (e.g., Budka 2021; Chirikure 2020a/b; Ogundiran 2020).

In a keynote lecture at the 2020 conference of the European Association of Archaeologists, Cornelius Holtorf stressed the importance of a more inclusive archaeology for promoting trust, collaboration and solidarity between communities (Holtorf 2020; see also Holtorf & Bolin 2020). Other researchers were more outspoken about necessary changes in this regard, e.g., Olson (2020) in a reply to observations on research in archaeology and social anthropology by Jobson (2020) and Rosenzweig (2020).

Archaeological excavations are costly, and it seems likely that in the coming years less funding will be available. While some of the already planned work will be resumed, archaeologists may have a hard time securing funding for new projects.

The knock-on effect of the COVID-19 crisis will be felt for a long time, particularly by graduate students and early-career archaeologists due to the disruptions of field and laboratory work, and reduced employment chances (Bloch 2020; Di Fiore 2020; Neves 2020; Velez 2021). A large survey with most participants from the USA showed that female archaeological researchers and students are most affected (Hoggarth et al. 2021).

Another concern is increased looting at archaeological sites and illicit trafficking of cultural heritage objects as the COVID-19 crisis has adversely affected the surveillance of archaeological sites (UNESCO

2020c). If more control cannot be put in place this development will very likely continue. There are projects that monitor websites on which objects are offered, e.g., the ATHAR Project¹, but looting must be prevented.

3 Preventive archaeology

Preventive archaeology concerns measures such as investigation and improvement of conditions at sites and rescue excavations due to development projects carried out by businesses of contract archaeologists or public institutions (e.g., preventive archaeology units of museums).

Contract archaeologists carry out mainly excavations as for most European countries pre-development evaluation by them as to whether archaeological remains are present is not allowed. The share of commercial service providers in developer-funded excavations varies, e.g., in 2015 in the Czech Republic 15-20% were conducted by 15 licensed private organisations (Mařík 2016: 49), in France around 30% by 19 accredited private firms (Randoin 2016: 62). Thus, in these and some other countries most excavations are carried out by public institutions, for example in France by ARIADNEplus partner INRAP, Institut National de Recherches Archéologiques Préventives. In Norway, almost all such work is being done by museums.

In contrast, in the Netherlands and the UK over 90% of preventive fieldwork is carried out by contract archaeologists, for example 2015 in the UK by 70 members of the Chartered Institute for Archaeologists, of which 46 carried out excavations (Perring 2016: 96-97); however, the larger members such as Oxford Archaeology and Wessex Archaeology are charitable trusts.

Based on results of a survey of the European Archaeological Council (2020) in August 2020 among their members it seems that many preventive fieldwork projects could continue and undertake at least some of the necessary rescue work, following the COVID-19 rules for such work. In rural areas there were fewer problems, while in cities it was more difficult.

Still, some archaeological companies had to furlough staff and terminate temporary contracts. The situation for smaller companies and self-employed archaeologists has become insecure. However, it appears that the impacts of COVID-19 are less severe than those of the economic crisis which began in 2007 and lasted for several years (Aitchison 2009; Cleary et al. 2014; Schlanger & Aitchison 2010).

Publications on the situation in the United Kingdom and United States provide more detail on how archaeological companies adapted their work to cope with the COVID-19 crisis (Aitchison et al. 2020; Douglass & Herr 2020; Head & Aitchison 2020; Lennox 2020; RESCUE 2020). For INRAP in France ARIADNEplus colleagues give an overview on impacts of COVID-19 on activities and mitigation measures taken (Salas Rossenbach et al. 2021; see also Garcia 2020).

Observers of the preventive archaeology sector cautioned that public authorities might relax regulations to allow development work to proceed without previous proper documentation and rescue of archaeological remains. This warning is not unfounded as there are many cases in which infrastructure development was indeed given priority. One COVID-19 example in Europe is the future site of the Parliament of Wallonia in Namur, Belgium, where the local authorities aimed to cut short necessary rescue work but backpedalled in face of strong community opposition (Vandeveldde & Pasquini 2020).

It is expected that in some countries, new public and private infrastructure development will help in the recovery from the COVID-19 impact, which could generate more work for contract archaeologists. The survey report of the European Archaeological Council (2020) states that members often

¹ Athar Project, <http://atharproject.org/media/>

mentioned “the potential increase in infrastructure development and investments (which usually accompanies governmental action to combat economic crisis), leading to increased demand for archaeological work, rise in contracts and employment in the sector”.

4 Cultural heritage museums

The COVID-19 crisis affected all museums, monuments and other heritage sites worldwide. Due to the public health protection measures, restrictions on mobility and a drastic decrease of tourism they have seen their attendance plummet and much income lost. However, to stay connected with their audiences, many cultural heritage institutions increased the digital communication, online access to and experiences of, cultural heritage.

Surveys on museums and other cultural heritage institutions

Several organisations conducted surveys on the impact of the COVID-19 crisis on cultural heritage institutions. Most of the surveys concern museums, including large surveys by major organisations during the first global lockdown and follow-up surveys: UNESCO (2020b, 2021a), International Council of Museums (ICOM 2020a, 2020b, 2021), and Network of European Museums Organisations (NEMO 2020, 2021).

In several countries heritage organisations carried out surveys, in Europe for example the Finnish Heritage Agency (2021) and the Observatorio de Museos de España (2020), in Colombia the Museo Nacional de Columbia & Ministerio de la Cultura (2020), in New Zealand the Museums Aotaroa (2020). In the United States the American Alliance of Museums has run surveys in June and October 2020 and April 2021 (AAM 2020a/b and 2021).

In addition to their museum surveys, UNESCO carried out a survey on World Heritage sites (UNESCO 2021b). Results are also available of a survey on Cultural Routes of the Council of Europe (EPA Secretariat & European Institute of Cultural Routes 2020), and on religious sites reported by Future for Religious Heritage (2020a/b).

The COVID-19 impacts on museums have been studied extensively, but we could not find a survey or other major report on archaeological museums specifically. There are also many articles by cultural heritage professionals on the impacts (e.g., the articles in Cobley et al. 2020; Informal Learning Review 2020; Historic England 2020), but publications about archaeological museums are rare. One interesting paper discusses three scenarios for museums and other public-facing archaeology to consider when planning their future (Gould 2020).

Most likely the impacts of the COVID-19 crisis on archaeological museums have been the same as on other museums. The main impacts reported by the available surveys are a large drop in the number of visitors and loss of income, hence financial disruption, and difficulty getting back to normal operation.

In some countries the losses have been partially compensated by the government, while institutions in others even faced cuts in regular subsidies. In the first ICOM survey in April–May 2020 with 1,600 respondents 12.9% feared they would have to close forever, another 19.2% said they were uncertain whether they will be able to continue (ICOM 2020a). In the third ICOM survey one year later with around 840 respondents the percentages were 4.6% and 12.5%, respectively (ICOM 2021).

Concerning museum staff and freelance professionals, ICOM (2021) reports that in their surveys the percentage of participants stating that employees have been laid off has risen steadily from 5.8% in May 2020 to 9.6% a year later.

The situation for freelance professionals remains critical: in Spring 2020 15% of survey participants stated they had been laid off (i.e., contracts terminated and not renewed), a year later it was 5% less. At that time 43.7% of museum respondents still expected that they would have to suspend freelance/temporary contracts. Conservators and restaurators have been particularly affected by the COVID-19 crisis, as reported by surveys on their situation in 2020 (ACRE 2020; CAC & CAPC 2020; Mantyniemi 2020).

Concerning what they can offer their visitors, in the ICOM survey in April–May 2021 48.9% of the museums expected that in future they will have to reduce exhibitions and 48.1% will have to reduce public programs; reduced opening hours was expected by 40.2%.

The shift to online cultural heritage communication and experiences

The main positive effect of the COVID-19 crisis was that it brought about an increased focus within cultural heritage institutions on digital communication, online access to and experiences of cultural heritage. All surveys on cultural heritage institutions mentioned above included a part on this.

Briefly summarised the surveys found that most online offers of closed museums, monuments and sites were those not requiring high funds and staff expertise, such as posting messages and using hashtags on social media platforms (e.g., Twitter, Instagram, Facebook)² and highlighting some already digitised collection content or objects. Online experiences which required more time, resources and skills to produce increased the least, for example online educational programmes, virtual museum visits (e.g., 360-degree museum tours), virtual reality exhibitions and 3D object exploration.

The ICOM survey in April–May 2020, with responses from around 1,600 museums and museum professionals in 107 countries (46.3% from Europe), gives an impression of museums' digital activities after the first global lockdown (ICOM 2020a). The survey question on their digital services included some basic categories, avoiding advanced formats and content such as virtual reality or 3D models which, however, could be subsumed under the category online exhibition or online collection.

The survey found that museum social media activities increased by 47%, quizzes/contests by 19%, live events 19%, collection online activities 18%, online exhibitions 16%, newsletters 13%, and podcasts 10%. Thus, there was quite an increase in digital activities, but apart from using social media channels the majority of respondents said these remained the same or there was no activity. For example, concerning online exhibitions 49% of respondents said there was no activity, 22% same as before, and 11% that such exhibitions were started after the lockdown (for online collection activities see *Chapter 7*).

For many institutions it was not easy to bounce forward by offering more digital services. Asked whether the museum had dedicated staff for digital activities, around 18% of respondents said no, 56% had such staff, but it was not their main domain of activity, and 26% said they work on digital activities full-time. Thus, at some institutions, staff with limited or no previous experience worked on digital communication, most using social media platforms.

Advanced digital content and experiences seen wanting

In articles about online communication and experiences offered by cultural heritage institutions there was a tendency to highlight virtual tours and exhibitions, often with a focus on 3D models and other

² Here two studies are available on how archaeological museums in Italy and Spain used social media, both focused on Twitter (Rivero et al. 2020; García-Ceballos et al. 2021).

advanced content (e.g., Ciecko 2020; McKeever 2020; Romano 2020); also compilations of online offerings for audiences in lockdown included mostly such content and experiences.³

There are good reasons to highlight such content and experiences, and these are also one of the focus areas of ARIADNEplus services (i.e., the ARIADNEplus Visual Media Services). Among the goals here are enabling adoption beyond well-resourced institutions and promoting innovative uses for archaeological and cultural heritage purposes. Demand for this exists.

Samaroudi et al. (2020) during April to July 2020 conducted a very detailed survey of the digital offerings of 83 heritage institutions in the UK and in the USA. They found that virtual visits in the form of 360° tours and views of exhibitions, VR/AR experiences or online audio tours were the least common types of digital engagement, with only 3% of those offered by institutions in the UK and 2% in the USA.

3D models of cultural objects were offered as part of digital content collections and guided explorations. At 1% this was the least frequently offered type of content. A study by the Europeana 3D Content Task Force (2020) showed that this is still a developing field and more support for cultural heritage institutions is necessary to make available functional 3D content that can be explored by users.

Academic articles which discuss digital heritage content and applications in the context of the COVID-19 crisis are often critical of the experiences offered. The researchers find that these mostly replicate in a shallow way the experience *in situ*, instead of using digital technologies to provide novel, alternative and engaging experiences of cultural heritage (e.g., Burke et al. 2020; Hoffman 2020; Lopez Rodriguez 2020; Orlandi 2020).

Although easily possible online, applications often present objects without rich description and historical context (Kahn 2020). Designed for audiences familiar with museum communication and exhibitions, the applications tend to create cultural “ghettos” (of those already interested) while excluding others from cultural participation, as argued by Lopez Rodriguez (2020).

In general, the communication is often one-way, from the institution to the audience, lacking an active dialogue about the content and experiences offered. Furthermore, the online offer is typically designed for single-user experiences, lacking tools for visitors to interact and share their views and ideas (Vayanou et al. 2020).

Hoffman (2020), addressing most of the shortcomings mentioned, concludes that these *“cannot be argued to be a result of rapid response to pandemic conditions, but rather is a product of museums’ long history of poorly articulating what ‘digitization’ means and viewing online potentiality through the lens of our physical world. While the casual viewer will chance upon enjoyment of the various online exhibitions and tours during the pandemic, it seems clear that for the most part online museum exhibitions betray an outmoded understanding of the digital with only a few transcendent examples.”*

In conclusion, in addition to providing cultural heritage institutions high-quality services for novel content and experiences (e.g., the ARIADNEplus Virtual Media Services), guidance and good practices are also needed regarding meaningful and engaging content and user interaction for study, education and enjoyment.

³ For example, European Commission, DG CONNECT: CulturalHeritage@home, <https://digital-strategy.ec.europa.eu/en/news/cultural-heritage-home>; Museum Computer Network: The Ultimate Guide to Virtual Museum Resources, E-Learning, and Online Collections (14 March 2020), <https://mcn.edu/a-guide-to-virtual-museum-resources/>

5 Impacts on ARIADNEplus

Compared to the impacts of the COVID-19 crisis on the archaeology and cultural heritage sectors overall the impacts on ARIADNEplus have been low or could be minimised by mitigation actions.

That there was no dramatic impact is due to the fact that ARIADNEplus mostly focuses on the use of digital technologies, and a strong existing core partnership also helped the project to overcome challenges. The main activity for which an online replacement was not possible is the Transnational Access (TNA) programme, which allows researchers visiting one of the project's competence centres. Consequently, the TNA programme had to be suspended. Other training offers such as tutorials at domain conferences could be moved online, in the form of webinars and the ARIADNEplus Training Hub⁴.

ARIADNEplus sessions at major conferences, co-organised events and project workshops all took place online, arguably with more participants than in-person meetings. For example, one very successful online event which ARIADNEplus co-organised was "3D Digital Cultural Heritage for Resilience, Recovery and Sustainability" (27 May 2020), in collaboration with the European Commission (DG CONNECT) and Inception s.r.l. The conference was streamed live on YouTube, with an audience participation count of 280-300 steady viewers and many who watched the recording thereafter.

All planned in-person meetings and other joint activities of partners are still digital, possible thanks to Web platforms and communication channels. The ARIADNEplus community adapted very well to this change, carrying on their work from home and in recent months from their research centres.

During the lockdowns, most data providers could continue working on their repositories and collections, using already implemented remote access or solutions quickly set up to carry out work on data and metadata online (see *Chapter 7*).

Most importantly, the COVID-19 crisis increased the recognition within the archaeology and wider heritage sector of the importance of proper data management, repositories of open/FAIR data, and discovery and access services. Thus, the crisis will probably increase the effect of the results of ARIADNEplus and its "sister project" SEADDA⁵ in this regard.

6 Changes in research methods

While the COVID-19 pandemic affects archaeology worldwide, the situation resembles the impact of the "Arab Spring" which disrupted archaeological fieldwork in countries in North Africa and the Middle East (see e.g., Casana 2013; Near Eastern Archaeology, 78.3/2015; Abdulrahman 2017). At that time archaeologists suggested focussing more on analysing already excavated but not studied material, and digitising and bringing online archival collections of investigations conducted in these regions for decades (e.g., di Lernia 2015; Mitchell 2019).

These are still valid suggestions, and regarding digitised and born-digital documents, available natural language processing (NLP) and data mining techniques offer much potential to exploit existing digital archaeological repositories (e.g., the NLP services of ARIADNEplus).

Scerri et al. (2020) argue that the field-based sciences must transform in response to COVID-19, building capacity for advanced remote collaboration based on digital research archives and platforms. Referring to the highly influential Marwick et al. (2017) paper on Open Science in Archaeology, they

⁴ ARIADNEplus Training Hub, <https://training.ariadne-infrastructure.eu>

⁵ SEADDA - Saving European Archaeology from the Digital Dark Age (COST Action), <https://www.seadda.eu>

emphasise that *“longstanding arguments by those in favour of Open Science must be more broadly accepted in a COVID-19 world. Ensuring the future of field-based science requires greater investment in communication, shared analyses, open data repositories and international perspectives. In particular, accessible new digital archives will form an important part of peer-review and assessment, thus improving the documentary quality and reproducibility of scientific results.”*

Scerri et al. (2020) also outline virtual research environments that are built on top of digital archives at different scales (i.e., sites and landscape level), and provide analysis and collaboration tools through which local research groups are supported by subject experts helping analyse remote-sensing data and finds virtually. Jarus (2021) mentions that such an approach was applied in 2020 in archaeological work near the city of Erbil in the Kurdistan region of Iraq as project members could not get there. He thought that it *“may become more common in 2021 and the years ahead. This method not only limits travel problems but also reduces or eliminates accommodation and airfare expenses”*.

Providing Cloud-based virtual research environments for archaeologists is one of the goals of ARIADNEplus (ARIADNEplus 2021: 52-67).

7 Work on online collection databases

In a survey on how UK research libraries adapted to the COVID-19 crisis, 61% of the 336 respondents indicated that COVID-19 had acted as a catalyst for change as it had *“encouraged or embedded pre-existing ways of working, at a faster pace”*. This concerned the rollout of systems for working remotely and the prioritisation of projects enabling the access to digital collections as well as the provision of online teaching content (Greenhall 2020: 11-12). Among the many results of this survey is that many written responses highlighted the importance of training and other support activities to promote digital scholarship and enable utilising the full potential of digital collections (Greenhall 2020: 29). In the coming years the digitisation of special collections and archives of academic libraries will gain in importance (Cox 2020).

Concerning museum online collection activities, in the first ICOM survey April–May 2020 around 33% of museums indicated that they did not provide such a service, 44% indicated there was no change in the level of activity, while 18% indicated an increase, and 4% had started activities. In comparison, in the third ICOM survey a year later 32% said the level of online collection activities was as before (12% less), 20% reported an increase (plus 4%), and 8% had started activities (plus 3%) (ICOM 2021: 16). Hence it appears that due to the COVID-19 crisis online collections gained in importance at many museums. Another question is whether the implemented collection management systems allow staff to work with them remotely from home.

A survey by the Collections Trust in the first weeks of the nationwide lockdown in the UK asked museums if staff and volunteers could access their collections database remotely to carry on working from home. Of the 265 respondents 113 (43%) said they could not. This problem was shared across museums of all types and sizes. Among the reasons were IT infrastructure not set up to support remote computers, a limited number of software licenses, only partially computerised collections data, staff lacking equipment or good internet connection. The article about the survey results concludes that this *“suggests a sector struggling with basic issues of digital resilience – and perhaps not just when it comes to collections data”* (Simpson 2020).

Among the ARIADNEplus data providers most could continue working on their collections. This was thanks to already implemented remote access to repository databases or solutions quickly set up to carry out work on data and metadata online.

Chris Nicholson, Director of ARIADNEplus partner Digital Antiquity, who manage The Digital Archaeological Record (tDAR) repository, notes: *“Because we have digital information stored in a service like tDAR (and there are many others), and the tools to access them, we can continue to work and provide a platform for others to do the same. The same cannot be said for many other archaeologists/historic preservationists”* (Nicholson 2020). He urges that archaeologists *“need to continue efforts in 1) converting our physical documents (those reports sitting on shelves gathering dust) to digital formats, 2) creating online platforms to access these items, and 3) planning for future work interruptions, whether they be from pandemics or other reasons. Making information and data accessible, either intra- or inter-office, truly is as important as ever.”*

In Turkey associated partner British Institute at Ankara (BIAA) did just that, preparing data and metadata for implementing a digital repository. Atalan Çayirezmez of BIAA describes how the repository team worked online using a digital platform to share documents and work on metadata. *“Given that the BIAA has existed for more than 70 years, files and folders generated over the course of this time needed to be organised on the digital platform in order to increase efficiency and performance. The availability of the platform has been a great benefit, and has allowed us to work online with interns and volunteers during the pandemic”* (Çayirezmez 2020: 10). Work on the repository concerned preparing assessment reports for the various collections, and learning about and applying the metadata and vocabulary standards ARIADNEplus suggests for datasets of collections.

BIAA’s digital repository team also translated into Turkish the PARTHENOS “Guidelines to FAIRify data management and make data reusable”. ARIADNEplus and SEADDA promote this FAIR data guide which was developed by the PARTHENOS humanities and social sciences research infrastructures project. Translated successively in different languages and available for download from the Zenodo repository, since December 2018 there were 2,666 unique downloads of this FAIR data guide (per 15 October 2021), 279 of the Turkish version made available in July 2020.⁶

8 Repositories for data access and reuse

The Figshare 2020 “The State of Open Data” survey in August 2020 published a snapshot of results based on responses of 3,436 researchers on how the COVID-19 crisis was impacting their ability to carry out research and their views on reusing available data (Baynes & Hahnel 2020). Among those saying that their research has been “extremely” or “very” impacted, laboratory scientists were most affected (e.g., in chemistry 47%), while researchers in humanities and social sciences much less (20%).

Due to the inability of many researchers to gain access to their lab or to carry out fieldwork there was an increased interest in reusing data (Baynes & Hahnel 2020: 24): 64% of respondents intended reusing their own data during lockdown and 65% planned to use it over the next 12-18 months; 58% said they had previously reused their own data. Reuse of data shared by other researchers was intended by 50% of respondents during a state of lockdown and 51% over the next 12-18 months; 44% reported that they had previously reused other’s data.

Actual reuse of data is difficult to identify and measure, but some digital repositories experienced increased access to and download of documents and data (Pool 2020). This happened also at archaeological repositories. In the ARIADNEplus repository survey in 2021 of 27 repositories that could collect and analyse access to their data, 24 said that during the COVID-19 pandemic overall there was an increase, reporting increases from 5% to over 100% (ARIADNEplus 2021: 45-46).

⁶ PARTHENOS Guidelines to FAIRify data management and make data reusable. Zenodo, <https://doi.org/10.5281/zenodo.2668479>; numbers given above are for unique downloads.

9 The pandemic and the FAIR data agenda

Observers of the sharing of COVID-19 related data from laboratories, clinics, public health organisations and others saw it as a change of research culture to a paradigm of Open Science and Open/FAIR data (Hook & Porter 2020). The OECD stressed that this was the right thing to do and that *“open science policies can remove obstacles to the free flow of research data and ideas, and thus accelerate the pace of research critical to combating the disease”* (OECD 2020).

In a position paper on COVID-19 and FAIR data CODATA, GO FAIR, Research Data Alliance and World Data System emphasised that the COVID-19 crisis made clear *“the fact that we need to meet both the immediate needs and long-term objectives of global science and accelerate the implementation of a FAIR ecosystem”* (CODATA et al. 2020).

Other observers felt that from the sharing of research data on COVID-19 some lessons can be learned by policy makers and researchers in other disciplines on why FAIR data are important and how it can be promoted, for example, *“The research data community has an important opportunity to use this hard won knowledge on the impact of FAIR in a pandemic, and accordingly shape the future of how we share data and research outputs”* (Khodiyar 2021).

However, many researchers are not yet ready to apply the FAIR data principles. The international Figshare “The State of Open Data” surveys found that in 2018 only 15% of the respondents claimed being familiar with FAIR, increasing to 18% and 24% in 2019 and 2020 respectively. There was also an increase in the proportion of respondents who had heard of FAIR but did not consider themselves familiar with the principles, 25% in 2018, 28% in 2019 and 31% in 2020 (Figshare 2018, 2019, 2020; Khodiyar 2021).

While there may have been an increased awareness among COVID-19 researchers of the open/FAIR data agenda, it is less likely there will be a broad impact in other research domains (Bobrow 2020). In archaeology some impact may have occurred indirectly, when archaeologists, not able to work in the field or laboratory, instead turned to digital archives to find data relevant for work on pause, prepare publications or design a new project. They may have recognised how important it is to have open access digital archives and information shared by other researchers, archaeologists as well as researchers of other fields from which they need reports and data.

10 No return to business as usual

The overall message to research organisations and researchers drawn from the impacts of the COVID-19 crisis is “no return to business as usual”, instead progress in Open Science practices should be promoted.

On 30 March 2020, UNESCO hosted an online meeting of representatives of ministries in charge of science from 122 countries to exchange views on the role of international cooperation in science and increased investment in the context of COVID-19. Open Science, for which UNESCO has been working on an International Recommendation since November 2019⁷, was a major topic of the meeting. UNESCO Director-General Audrey Azoulay declared, *“The COVID-19 pandemic raises our awareness of the importance of science, both in research and international cooperation. The present crisis also demonstrates the urgency of stepping up information sharing through open science. The time has come for us to commit all together”* (UNESCO 2020a).

⁷ UNESCO: Open Science, <https://en.unesco.org/science-sustainable-future/open-science>

The benefits of Open Science practices, like open sharing of research data and publications, have been exemplified in research on COVID-19. Representatives of research funders, associations, repositories and other stakeholders now want to see the practices adopted in all fields of research (e.g., Barbour & Borchert 2020; COAR 2020; CODATA et al. 2020; European Commission⁸; International Science Council 2020; OECD 2020; SPARC Europe 2020).

In archaeology the request to follow open research practices is not entirely new, it has been voiced by researchers for several years (e.g., Beck & Neylon 2012; Beck 2013; Costa et al. 2012; Kansa 2012; Lake 2012; Marwick et al. 2017; Wilson & Edwards 2015). Particularly the *Open Science in Archaeology* paper by Marwick et al. (2017), published by a large group of recognised archaeological researchers, has greatly added to the awareness of the Open Science agenda in the field.

The overall vision of Open Science is making the research process and its results as transparent and accessible as possible to increase societal benefits which can be derived from scientific and technological knowledge. It is highly relevant for archaeology where excavation of sites – by academic or contract archaeologists – destroys the primary evidence, hence the data generated to document it, reports and publications should be easily accessible to other researchers and the interested public. Archaeological work to preserve, research and communicate archaeological heritage is generally carried out in the public interest and therefore requires a strong commitment to transparency and openness.

Open Archaeology, including open sharing of research resources (methods, tools, data), novel forms of research collaboration, and a deeper involvement of citizens, can greatly extend the societal relevance and reach of archaeological knowledge. However, many archaeologists are not yet well prepared for Open Science practices. As the matter is complex, strong leadership regarding policies/mandates, supportive institutional measures (e.g., capacity building, training of researchers), and state-of-the-art digital repositories are necessary.

In coming years archaeologists will face many challenges and the community could benefit from adopting Open Science practices in its efforts to overcome them. Rather than trying to go back to business as usual, creativity and openness to new ways of working are needed.

11 Summary of results and suggested actions

This study has been carried out to understand the consequences of impacts of the COVID-19 crisis on the sectors of archaeology and cultural heritage, and how ARIADNEplus could contribute to recovery, beneficial changes in practices, and future resilience.

The COVID-19 crisis has had profound impacts on archaeological research and cultural heritage communication. In comparison, impacts on ARIADNEplus have been low or could be minimised by mitigation actions. That there was no dramatic impact on ARIADNEplus is due to the fact that the project mostly focuses on the use of digital technologies and has a strong existing core partnership.

Impact on archaeology

In academic archaeology, site-based fieldwork and public archaeology, as well as laboratory work has been affected. Planned fieldwork campaigns and field schools with students and volunteers in 2020 and 2021 had to be cancelled. In coming years less funding for archaeological projects may be available.

⁸ European Commission: Open Science, https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/open-science_en

The impact on preventive archaeology carried out by companies and public organisations appears to be lower, at least compared to the economic crisis some years ago which forced many contract archaeology businesses to close. However, some companies had to furlough staff and terminate temporary contracts; the situation for smaller companies and self-employed archaeologists has become insecure.

In academic archaeology the knock-on effect of the COVID-19 crisis will be felt for a long time, particularly by graduate students and early-career archaeologists due to the disruptions of field and laboratory work and reduced employment chances. Established archaeologists had more time to analyse data from past field seasons, prepare publications, and applications for new research and public archaeology projects.

Also, an increase in access to available data in digital repositories has been observed, and it seems likely that the COVID-19 crisis made archaeologists more aware of the importance of publicly shared data, data repositories and discovery and access services.

In addition to looking for reusable new and legacy data, archaeologists also explored tools for improving digital documentation and online platforms for collaborative research, including support of small local teams, where fieldwork was possible.

Conclusions and suggested actions

The main conclusions for ARIADNEplus are:

- The COVID-19 crisis arguably increases the effect of the work of ARIADNEplus for proper data management and sharing, digital repositories, and data discovery, access and use for archaeological research.
- Therefore, more may be achieved by promoting and possibly increasing what the project can offer.

Suggested actions:

- *Capacity building*: Increase promotion of resources for capacity building in data management and sharing, for example guidelines (e.g., the PARTHENOS FAIRify Guide), training resources (e.g., the ARIADNEplus Training Hub), training webinars in collaboration with SEADDA, and practical tools (e.g., the online Data Management Plan tool).
- *Data Portal*: Over the coming months more datasets will be included in the new Data Portal, which with additional features has become an effective research tool. Demonstrate the new capabilities when new national and thematic datasets are being released.
- *Special services*: Demonstrate the use of already available special services, for example, the Cloud-based Natural Language Processing service which supports extraction of information from archaeological documents such as fieldwork reports. Archaeologists who, due to the COVID-19 crisis, could not carry out fieldwork to collect new data showed interest in exploiting already existing documentation.
- *Virtual Research Environments (VREs)*: Archaeologists also used online platforms to carry out research tasks, for example virtual support by subject experts of a local group of archaeologists. ARIADNEplus aims to provide VREs for different tasks and data types. When VREs become available their advantages could be demonstrated in experimental case studies prior to the larger ARIADNEplus Pilots.

Impact on cultural heritage

The impact of the COVID-19 crisis on cultural heritage institutions such as museums, monuments and other heritage sites and routes has been tremendous. Due to a drastic decrease in tourism and local attendance they have seen their in-person engagement plummet and a lot of income has been lost. The situation for many institutions and their staff has become insecure and even more so for freelance professionals.

The main positive effect highlighted by all impact surveys is that the COVID-19 crisis has brought about an increased focus of cultural heritage institutions on digital communication, online content and experiences of cultural heritage.

What increased most was use of social media platforms whereas offering online experiences which required more time, resources, and skills to develop them was less common. Where well-resourced institutions had already invested in online educational programmes, virtual museum visits, online exhibitions, and 3D models of heritage objects these were of course re-activated and promoted.

Media articles on what cultural heritage institutions offered often highlight virtual tours and exhibitions, 3D models and other advanced content. Academic articles which discuss the online content and applications see shortcomings in several respects, shallow replication of the experience *in situ*, lack of rich description and historical context, one way-communication instead of a dialogue with audiences, among others.

Conclusions and suggested actions

The main conclusions for ARIADNEplus are:

- The project focus is not on improving the online communication, content and experiences offered by cultural heritage institutions.
- However, some services developed for researchers could be relevant also for other purposes such as heritage presentation and learning about archaeological sites and objects.
- Therefore, enabling use of such services, particularly beyond well-resourced institutions, should be considered.

Suggested actions:

- *Cultural heritage / archaeological online collections:* Collections are being used for heritage research as well as other purposes. Investigate with museum partners how different ARIADNEplus services could improve heritage presentation, education, and other uses of collections.
- *Novel content and applications:* The ARIADNEplus Visual Media Services (VMS) are relevant for institutions interested in using 3D models for the presentation of heritage objects and sites. It is already planned to demonstrate the VMS to institutions and explore existing demand and specific requirements. In addition to high-quality services, guidance and good practices may also be needed regarding meaningful and engaging content and user interaction for study, education, and enjoyment.

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