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Open archaeology. Advances and challenges in the management of archaeological contents

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Abstract. During the last two decades there has been a crucial change in the ways of producing, accessing and using information from all branches of knowledge, including archaeology. Concepts such as open data and content, open access, free software, social construction of knowledge, etc. have been installed in the theory and practice of scientific research (open science) and administrative management (open government) to become an outstanding potential vector for the advancement of scientific knowledge, the economy based on use of data and the transparency of institutions. In the field of cultural heritage, the democratization of knowledge, social participation in public management or the rise of cultural tourism, also affect the increasingly close relationship between the academic, professional and administrative fields and these, in turn, with a population that ceases to be exclusively passive recipient of the information filtered from these areas, to become involved in many of the aspects that concern its management. In this context, archaeology shows some singularities that will be discussed in this paper, focusing on the Spanish case. For this purpose, the advances that have taken place in the generation of open archaeological contents will be reviewed, as well as the main remaining challenges.
Keywords: Open archaeology, open data, open access, open government, digital contents.

[es] Arqueología abierta. Avances y desafíos en la gestión de contenidos arqueológicos

Resumen. Durante las dos últimas décadas se ha producido un cambio crucial en las formas de producir, acceder y usar la información procedente de todas las ramas del saber, incluida la arqueología. Conceptos como datos y contenidos abiertos, acceso y código abierto, software libre, construcción social del conocimiento etc. se han instalado en la teoría y en la práctica de la investigación científica (ciencia abierta) y la gestión administrativa (gobierno abierto) hasta convertirse en un destacado vector potencial para el avance del conocimiento científico, la economía basada en el uso de los datos y la transparencia de las instituciones. En el campo del patrimonio cultural, la democratización del conocimiento, la participación social en la gestión pública o el auge del turismo cultural, también inciden en la relación existente entre los ámbitos académico, profesional y administrativo y estos, a su vez, con una población que deja de ser receptora pasiva de la información filtrada desde dichos ámbitos, para implicarse en aspectos que atañen a su gestión. En este contexto, la arqueología presenta singularidades que serán analizadas en este trabajo, en el que se revisarán, especialmente para el caso español, los avances producidos en la generación de contenidos abiertos y los principales retos en esta materia.
Palabras Clave: Arqueología abierta, datos abiertos, acceso abierto, gobierno abierto, contenidos digitales.

Sumario. 1. Introduction. 2. Regarding data, information and knowledge. 3. Open access to information and knowledge. 4. Open archaeological data. 5. Coordinated and collaborative open management. 6. Conclusions. Acknowledgements. References.

Como citar: Fernández Cacho, S. (2021): Open archaeology. Advances and challenges in the management of archaeological contents. Complutum, 32(2): 443-457.

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1. Introduction

The concept of Open Archaeology has started to make inroads in the context of a change in the forms of generation, access and use of information and knowledge in all branches of learning and in the administration and management of public organisations, especially since the publication in 2012 of an issue of *World Archaeology* devoted to the topic. In its Introduction, the journal's editor, M. Lake (2012), alludes to the limited interest that this topic arouses in the academic sphere, to all appearances poorly informed about its potential.

In this paper Open Archaeology will be understood as a set of procedures and practices that enable the unrestrained cost-free enjoyment and reuse of information across all the aspects of its research and management. With the expression 'know to protect' having become an institutional byword for archaeological inventorying in Spain from the 1980s on (Querol and Martínez 1996: 212 & ff.), the shackles are now coming off this knowledge, enabling the detection of inconsistencies and gaps, the generation of new knowledge and the conveyance of the archaeological heritage's values. This is key for archaeological heritage to be brought back to the present through being socially and economically energized. Thus, not only is the spotlight put on its -always necessary- legal protection, but also on its valuation and safekeeping through the greater involvement of a set of social stakeholders, including public institutions and research centres who interact with it through their professional practice, as well as civic associations, or visitors driven by intellectual curiosity.

Through this optic, the three best-known challenges to the development of true Open Archaeology will be highlighted, even though the borders between them are fuzzy. In the area of digital contents management these are:

– The open access to information and knowledge
– The freeing-up of archaeological datasets for their reuse
– The progress towards governance models that encourage the collaboration, coordination and participation of the set of stakeholders and their involvement in information and knowledge production, processing, access, use and dissemination.

2. Regarding data, information and knowledge

To simplify the concepts, it can be said that data are the raw material of information and knowledge generation. Large quantities of data are produced, but alone they do not enable conclusions to be drawn nor contribute to any decisions to be made. When these data are grouped, contextualised and organised, information can be obtained, that is, phenomena can be recorded and meanings can be attached. This information shows the relationships between the data and gives answers to questions such as who, what, where and when. For its part, knowledge is the result of filtering, interpreting and enriching information, of processing it in consideration of a previous conceptual framework in such a way that, the more it is enriched through experience, the closer one comes to attaining knowledge (or wisdom). Knowledge is guided towards actions and decision-making in more complex contexts. Knowledge and wisdom respond to questions such as the why and the wherefore of phenomena, i.e., towards their patterns and origins (García 1998; Bellinger, Castro and Mills 2004; Prada 2008) (Figure 1).

Digital contents include data, information and knowledge presented in digital format and can blend simple data, metadata, texts (structured or not), sound files, videos, images, cartography, software, etc., i.e., any type of human creation that can be accessed through digital tools (Vivar and Vinader 2011)

For example, if one accesses the open file record for the Roman town of Carteia (in the town of San Roque, Cadiz province) in the *Digital Guide of Andalusian Cultural Heritage* (https://guiadigital.iaph.es) over 30,000 characters present the data in an interoperable format (.jsonld), e.g., …"tipologia_smvList":{"tipologia_smv":["Ciudades","Castillos","Asentamientos","Construccionesfunerarias","Ciudades","Construcciones funerarias"]},"….

All of these data are insignificant on their own, but grouped together and organised into an information record on Carteia in conjunction with other digital contents such as photographs, cartography and documents, they offer information of some importance. Although the information given may be sufficient for some purposes (planning a visit, using in some instructional activity, checking the protection level, etc.), it will have to be related to and en-
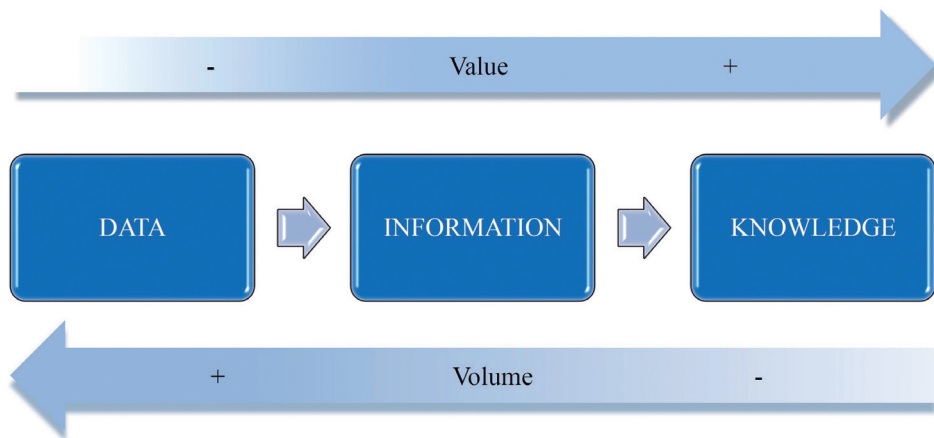
Figure 1. Data, information and knowledge. Prepared by the author inspired on (Ponjuan 1998: 2).

riched with a great deal of other information from, for example, the archaeological record of the excavations carried out there, the territorial and landscape context, studies of artefacts deposited in museums, a comparative analysis of other sites, etc., to produce knowledge in the shape of a scientific monograph, for instance. The monograph will enable trends to be identified and generalisations to be made, and will help to explain phenomena. The greater the scope of these phenomena, the more and the better related they can be to prior experience, i.e., to the previously-generated knowledge on similar phenomena such as Romanisation, evolution of construction techniques or commercial activities in Mediterranean regions in Antiquity, among many other things.

It is easy to infer from all this that the availability of more data will normally result in a greater volume of information which, the more accessible it is, will generate more and better knowledge for action to be taken or reliable decisions to be made. In contrast, a lack of data will lead to a lack of information and knowledge, which will result in inaction or incorrect actions. Although all these things may seem obvious, they are not so obvious if we resort to an analysis of their quality or objectivity. However, data availability also enables these aspects to be addressed and, consequently, their uncertainty to be handled with a greater or lesser degree of accuracy (Tobalina-Pulido and González-Perez 2020).

Despite access to knowledge being increasingly well-established in scientific practice, open access to data is still not a wholly integrated part of this. Sometimes data are published with licences that do not allow them to be freely reused, and very often they do not comply with all the criteria for being totally open (findable, accessible, interoperable and reusable) and are only anecdotally linked, i.e., connected to other data (Figure 2).

3. Open access to information and knowledge

According to UNESCO, open access to scientific information is the online availability of scholarly information to everyone, free of most licensing and copyright barriers (UNESCO 2021). Normally it refers to peer-reviewed scientific publications, although it can also include other academic, educational and creative archives.

The first initiative of any importance to promote open access was launched by the Open Society Institute in Budapest in 2001, but it was when the Max Planck Foundation sponsored the Berlin Declaration in Germany two years later that a greater consensus was reached around a set of commitments for member organisations. Since its enactment, the declaration has been endorsed by 665 scientific institutions, funding agencies, archives, libraries and museums, whose open access policies are widely supported by public institutions, including 65 in Spain.

The *Directory of Open Access Journals* (DOAJ) was subsequently launched at the Lund University (Sweden) in 2003 (https://www.doaj.org). Funded by a wide range of libraries, publishers and other organisations, the DOAJ contains at present 16.336 peer-reviewed open access journals from 126 countries all over the world.
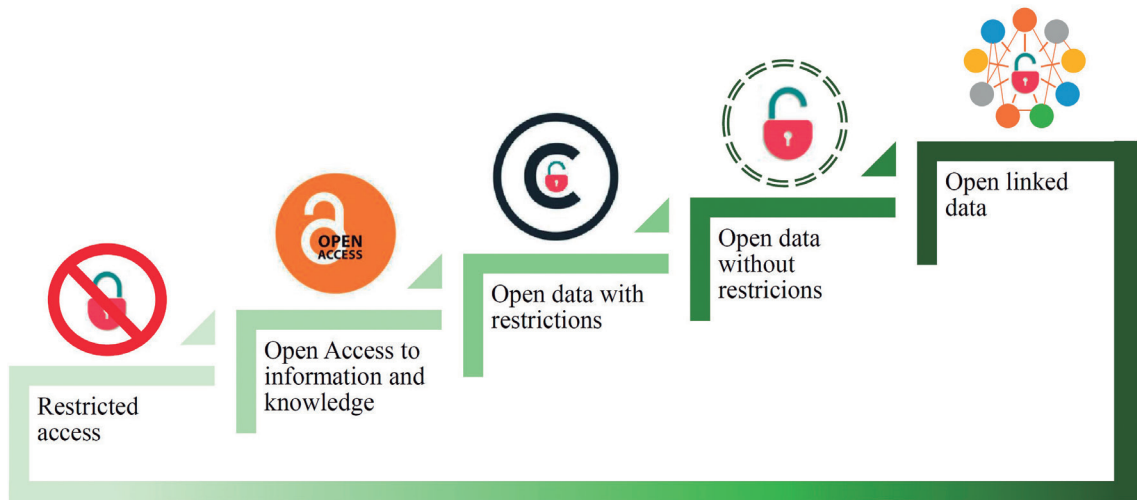
Figure 2. Sequence for the release of digital contents.
Prepared by the author inspired on (Berners-Lee 2012).

Other initiatives have been taken since then and have continued to drive policies for open access to scientific knowledge by way of a number of the Unesco and European Union support mechanisms for their implementation (Table 1).

One reliable approximation of the number of open access archaeological publications was given on the University of New York's *Ancient World On Line* (AWOL) blog in December 2020 as 1,934 titles, including the best-known Spanish journals such as *Complutum* (Complutense University of Madrid), *Trabajos de Prehistoria* (CSIC), *Spal* (University of Seville) and *Cuadernos de Prehistoria y Arqueología* (University of Granada) (Institute for Studies of the Ancient World, 2020). It should be noted, however, that some of these journals have recently applied open access policies. The first Spanish open access electronic journal specialized in archaeology, *ArqueoWeb*, was created by PhD students from the Complutense University of Madrid in 1998 (https://webs.ucm.es/info/arqueoweb/).

The process to convert these print scientific journals into open access journals, and the publication of new journals in this format through the exploitation of the Internet has been a success. Meanwhile, university repositories are becoming great storerooms of their research personnel's scientific production. They are, thus, taking control of the knowledge that they generate, which, to date, has been in the hands of publishers who, with a limited investment compared to the cost of the research, have se-

cured large profits (Kansa 2012). Nevertheless, some of the funding, legal and scientific issues that open access (and open data) entails are still up for debate, including in the area of archaeology (Costa et al. 2012; Hugget 2015; Salisbury 2017).

There is a very relevant unique feature of archaeological practice in the generation of digital contents. A great deal of archaeological information and knowledge also exists outside the academic circuits. What happens to the large volume of information obtained after hundreds of archaeological interventions only partially published or totally unpublished in the academic media? How can the 'grey' literature in the archives of the public administrations be accessed?

These documents do not have the scientific guarantee of a peer review, but they can offer major support, not only for archaeological management tasks, but also for scientific research and new knowledge generation. Such is the case of archaeological site and materials inventories and reports and records of archaeological interventions. Despite being limited, the information that the former provides about many both movable and immovable archaeological objects is structured and potentially reusable, whereas the latter provide a greater amount of information and knowledge about specific archaeological effects and contain descriptive and interpretative texts that are more difficult to process automatically.

In general, archaeological activities can be carried out at the behest of the organisation in charge of managing the archaeological her-

Date	Milestone	Purpose
2003	Berlin Declaration (https://openaccess.mpg.de/Berliner-Erklaerung)	To promote open access to scientific documents.
	Directory of Open Access Journals (https://www.doaj.org/)	To increase visibility, accessibility, reputation of use and impact of quality academic research journals.
2007-2012	European Union OpenAir and OpenAir Plus projects (https://www.openaire.eu/)	Open access infrastructure to support the implementation of open access in Europe.
2008	Policy Guidelines for the Development and Promotion of Open Access (Unesco, 2008)	To provide information to those responsible for open access policies in all countries.
2011	Global Open Access Portal (http://www.unesco.org/new/en/communication-and-information/portals-and-platforms/goap/)	To promote open access in member States to facilitate understanding of its most relevant aspects.

Table 1. Open access. Main milestones cited in the text. Prepared by the author.

itage, whether for protection or safekeeping (museums), by professionals who do so as part of environmental impact assessments, or by public organisations research teams, such as universities, research centres or museums, usually taking part in broad scope projects. One of the problems of the information obtained in them is that it is generated by various administrative, professional and academic agents for different purposes and with different priorities. This makes it very complex to manage in a homogenous way, as there are no standardised units and resources for systematic documentary work that enable the required IT systems to be kept up to date.

The University of York's Archaeology Data Service (https://archaeologydataservice.ac.uk/) has been an outstanding leader in this field from very early on. By exploiting the opportunities provided by the Internet, as far back as 1996 it was offering infrastructure to guarantee the integrity, reliability and long-term accessibility to its contents focused on research in the United Kingdom (Richards 1997, 2017; Kansa 2012). The benefits are self-evident, especially for those who need to go through a large volume of grey literature on archaeological interventions for their professional, research or teaching work (Costa *et al.* 2012: 453; Huggett 2015: 25; Richards 2017).

Progress made towards free access to similar documents in Spain is still lacking. Open access to archaeological intervention reports is only possible in Catalonia thanks to the *Calaix* digital repository (http://www.calaix.cat/), developed in collaboration with the Consortium of Catalonian University Services. This repository holds a total of 5,338 records of interventions,

and although not all are accompanied by a report, they at least present metadata indicating their author/s, site location and chronology with the inclusion (or not) of inventories of stratigraphic units and archaeological materials.

Open access to inventory databases and catalogues of archaeological sites and materials is more widespread, often with restrictions. The information given in these instruments is much more structured and can be more easily transferred to IT data management tools. There are substantial differences in the volumes of information published in different countries and regions. Some only allow total or partial access to information on protected archaeological sites, while others permit much broader access to all known archaeological sites. Such is the case of France, which offers information on over 500,000 archaeological undertakings in the country recorded in its *Atlas des Patrimoines* (http://atlas.patrimoines.culture.fr) (Lorbo 2014).

Open access to this information is not widespread in Spain. Catalunya and Andalusia are leaders in making it publicly available. In Catalonia, the inventory of archaeological and paleontological heritage can be viewed online and offers a set of structured data on its identification, description (with access), protection, interventions and information sources (https://sig.gencat.cat/portalsigcultura.html). Every file or record includes images for the object's identification and basic 1:50,000 scale cartography for its localisation. This is complemented with the delimitation on a more detailed scale of almost 12,000 archaeological sites that can be examined through a map viewer.

The inventory of archaeological sites in Andalusia was digitised and disseminated online

in 1999 (Díaz 2002). In collaboration with the central and peripheral services of the Andalusian Government's cultural administration, the Andalusian Institute for Historical Heritage's (IAPH) Documentation and Studies Centre has succeeded in systematising, standardising and digitising archaeological information that currently includes some 16,000 sites. This information can be accessed through the *Digital Guide to the Cultural Heritage of Andalusia* (https://guiadigital.iaph.es/). It also contains the locations of sites recorded in the General Catalogue of Historical Heritage with the exception of caves and shelters with rock art, due to their special vulnerability.

Be that as it may, the still poor coordination between different administrations and the lack of official support for open access policies make it difficult to update the information, which does not usually include that found in the inventories and catalogues prepared by the public administrations as a whole, such as the information from regulated archaeological surveys.

Information on archaeological materials is even less accessible. Materials inventories are usually included in archaeological intervention reports but are not usually organised into open access databases except in the case of those provided by museums, which do not cover the enormous quantity of archaeological objects deposited in them. It is possible to review the most important materials in these repositories via the Spanish Digital Network of Museum Collections (http://ceres.mcu.es) thanks to the use of the same collection management system, Domus, sponsored by the Spanish Government. The use of standardised language and structured data enables information to be filtered by multiple descriptors. However, the only way to download this information is by individually downloading a .pdf of each of the inventoried objects.

Despite the enactment of European directives and State and regional legislation on the reuse of public sector information and the promotion of open access policies, their application to archaeological documents held by the administrations responsible for the cultural heritage is a goal that has still not been reached. Academic institutions do not usually share information either, and it reaches third parties almost exclusively through scientific publications, with limited access to the grey literature that they generate or the data on which knowledge is built.

4. Open archaeological data

Since the enactment of Directive 2003/98/CE concerning the reuse of public sector information (European Union 2003), a number of milestones have been reached on the path to facilitating and moving forward in the publication of open data in Europe with the use of interoperable formats to stimulate the economy through the development of the new products and services that come from the different ways of combining and exploiting these data (Cerrillo-i-Martínez 2012). Table 2 gives some of the most important milestones, including those related to the sphere of the cultural heritage, in general, and archaeology, in particular.

From 2003 until the Directive was updated in 2019 to include, among others, the concept of 'open data' (European Union 2019), awareness of the need to disseminate datasets for their reuse has grown exponentially. A significant milestone in the area of cultural heritage on the European scale was the launch of *Europeana* as a major collector of European heritage digital contents, including scientific documents, images, videos, sound files, etc. In July 2021, Spain was in 9th place in searches for digital contents in *Europeana* using the descriptor "archaeology" (with its linguistic variables) with a total of 22,303 items. This was a long way behind Sweden, in first place with 671,072 items, but also a long way in front of those in last place, Denmark with 6.

A recent advance in searches of sets of open data on the international scale came into operation in January 2020: *Google Dataset Search*. According to the search engine itself, had indexed almost thirty million datasets by August 2020. When a search is made using the descriptors "archaeology" + "Spain", this tool retrieves 20 datasets. The most significant of these for archaeological research is the 2015 Antonio Gilman archive of radiocarbon determinations currently integrated into *Idearq* (http://www.idearqueologia.org/), the Spanish Higher Research Council's (CSIC) spatial data infrastructure for the online publication of geo-referenced archaeological scientific data, which focuses on Levantine caves with rock art stable isotopes and radiocarbon determinations.

The availability of geo-referenced archaeological data is another goal on the path to Open Archaeology. The European Union's INSPIRE Directive (2007) created standards for environmental geographical data to ena-

Date	Milestone	Purpose
2003	Enactment of Directive 2003/98/CE of the European Parliament and the Council of 7th November 2003, concerning the reuse of public sector information (European Union, 2003)	General regulation for the reuse of public sector documents in Europe to stimulate the development of new products and services.
2006	Open Context (https://opencontext.org/)	Publication and preservation open archaeological content.
	The Digital Archaeological Record (tDAR) (https://core.tdar.org)	Online archive for archaeological information.
2007	Law 37/2007 of 16th November, on the reuse of public sector information	General regulation for the reuse of public sector documents in Spain to stimulate the development of new products and services.
2008	Europeana (https://www.europeana.eu)	Open content to support the digital transformation of the cultural heritage sector.
2008	Hispana (https://hispana.mcu.es)	Portal for access to Spanish digital heritage and national content aggregator for Europeana.
2011	Spanish open data portal (https://datos.gob.es/)	Single point of access to public administration datasets.
2012	Journal of Open Archaeological Data (https://openarchaeologydata.metajnl.com/)	To describe and enable open archaeological dataset searches.
2013 / 2020	ARIADNE and ARIADNEplus (https://ariadne-infrastructure.eu/)	To integrate archaeological datasets on the European scale.
2019	Directive (EU) 2019/1024 of the European Parliament and the Council of 20th June 2019, concerning open data and the reuse of public sector information (European Union, 2019)	Revision of Directive 2003/98/CE to improve the exploitation of public sector information in Europe.
	SEADDA (https://www.seadda.eu/)	Community of archaeologists and digital specialists working together to secure the future of archaeological data across Europe and beyond.
2020	Google Dataset Search (https://datasetsearch.research.google.com/)	To help locate open and reusable datasets.

Table 2. Open data. Main milestones cited in the text. Prepared by the author.

ble information to be shared among member states. These include protected cultural heritage, which in most countries means a very small percentage of their known archaeological sites (McKeague *et al*. 2020). However, archaeological fieldwork entails a large quantity of both small- and large-scale geographical data that can be shared and reused: from archaeological locations identified in surveys and inventories through basic graphical representation (usually by points or polygons) or through data obtained from aerial photographs or satellite images, to stratigraphic excavation records (Previtali and Valenti 2019).

One of the reasons for the very limited publication of open data is the format usual-ly used by scientific journals, which does not encourage the inclusion of large data tables and means that only the most significant are published in .pdf format (Costa *et al.* 2012; D'Andrea 2013). Alternative types of media have emerged to publish these data with quality filters that enable their recognition in academic *curricula*. One of these is *Open Context*, created in 2006 by the not-for-profit organisation Alexandria Archive Institute in collaboration with the University of California library. Any type of content related to archaeological research in the world can be published on this platform, including documents, images, maps, vocabularies, artefacts, ecofacts, etc. (Kansa and Kansa 2013; Kansa 2016). A simi-

lar platform in the U.S. with some differences that will not be listed here is *The Digital Archaeological Record* (tDAR) (Sheehan 2015), created for the same purpose and in the same year as the previous platform by the Center for Digital Archaeology in collaboration with other institutions. As of the beginning of 2021, neither of these two repositories contains any datasets published by Spanish organisations.

Another indexed and peer-reviewed journal that publishes open archaeological data is the *Journal of Open Archaeological* Data. *This* journal was created in 2012 to disseminate archaeological datasets through the publication of their description (methodology used for their creation, structure and potential reuse) and place where held, as they have to be published in open repositories. In this case, the data also usually come from scientific research on a very wide range of aspects such as land surveys, radiocarbon dating, geoarchaeological, archaeobotanical, zooarchaeological and palaeobotanical data, etc. During the 8 years it has been in existence, this journal has disseminated a total of 38 open archaeological datasets, only one of which was Spanish (Pardo-Gordó 2019). This number is not at all representative of the volume of archaeological interventions that have been produced in the national and international contexts. It is clear that, except for some isolated initiatives, there has still been no move towards promoting the open publication of research data in the academic sphere, despite universities developing portals for this purpose and their library services providing technical support to researchers.

The cost of data processing for open publication, the scant availability of time and technological knowledge, research evaluation systems that do not consider data and resistance to sharing data due to a generalised sense of ownership may be other reasons for this situation. However, this freeing up of information could benefit the social perception of the usefulness of the discipline itself and the justification of the costs that it generates, as well as —and above all— preventing the loss of data through inappropriate management of their life cycle (Kansa and Kansa 2013; Faniel *et al*. 2018; Aspöck 2019) (Figure 3).

In the national context, in 2007 the Government of Spain transposed Directive 2003/98/CE into national law, created *Hispana* in 2008 as a portal to access digital heritage and a national aggregator for *Europeana* -ten years lat-

Figure 3. Data life cycle according to Faniel et al. (2018).

er it was providing almost 65% of Spanish records (Agenjo-Bullón and Hernández-Carrascal 2019)- and in 2011 launched its open data portal. According to the portal itself, in 2011 it contained a total of 443 datasets and this number had grown to 28,554 in November 2020. On this last date, the availability of datasets for cultural heritage in general and archaeology, in particular, was (and continues to be) rather irrelevant. The latter include archaeological datasets of a spatial nature (with their metadata) for the Autonomous Community of Valencia (data for 1998), an inventory of religious buildings and castles in the Basque Country and a dataset of almost 25,000 buildings (including archaeological buildings) taken from the *Digital Guide to the Cultural Heritage of Andalusia* (https://guiadigital.iaph.es/), which offers all its contents as linked open data and with no restrictions on its use.

Other institutions can be found that provide token archaeological data in Spain, including the autonomous communities (regions), which provide data on their protected assets (e.g., Cantabria and Castile-La Mancha), local councils (e.g., Arganda del Rey), and other public institutions such as museums, archives, libraries, research centres, etc. Amongst these last, there are some that stand out for having become involved in projects funded by the European Union with the main aim of publishing archaeological data on the continental scale. They include the ARIADNE and ARIADNE-

plus (*Advanced Research Infrastructure for Archaeological Data Networking in Europe*), research infrastructure created for sharing in Europe, which currently holds 2,000,000 archaeological datasets and is integrated into the National Research Centre for Human Evolution (CENIEH) and the University of Barcelona, as well as the development of SEADDA (*Save European Archaeology from the Digital Dark Age*), a community of specialists in archaeology and digital infrastructure whose purpose is to drive coordinated actions for the management, archiving, preservation, dissemination and reuse of open archaeological data and involves not only CENIEH but also research personnel from CSIC and the Universities of Santiago de Compostela and Zaragoza (Aspöck 2019). In this regard it is important to note that most of these projects are partner-based, which means that institutions not directly involved in the projects get little support to participate and no funding, creating not only a digital gap but also inequality in data representation.

5. Coordinated and collaborative open management

This is, perhaps, the most difficult point of adjustment for developing Open Archaeology in all its dimensions, including its social dimension, as it entails a substantial change to current models of heritage management. Diverse legislation initiatives seek to spark new models of participative governance, including in the area of heritage (Table 3).

In 1990, Icomos adopted the International *Charter for the Protection and Management of Archaeological Heritage* which stipulates that participation by the public has to form part of conservation policies (Art. 2) and also states that this participation has to be knowledge-based and can even extend to site management (Art. 6) (Icomos 1990).

In 2000, the Council of Europe enacted the *European Landscape Convention.* Although it did not apply solely to landscapes of cultural interest, it gave a major boost to the principle that landscape management cannot be achieved successfully without the involvement of the public in the decision-making process (Art. 5) (Council of Europe 2000). Subsequently, the *Council of Europe Framework Convention on the Value of Cultural Heritage for Society* (Council of Europe 2005) was adopted in Faro, this time directly applicable to the management of the cultural heritage. The convention not only supported democratic public participation in heritage management but also encouraged the adoption of measures to promote synergies between the competences of all the affected public, private and institutional stakeholders (Art. 1). In 2017, the Council published its European Cultural Heritage Strategy for the 21st Century, which established three main components: the social component, sustainable territorial and economic development and knowledge and education (Council of Europe 2017).

Date	Milestone	Purpose
1990	International Charter for the Protection and Management of the Archaeological Heritage (Icomos, 1990)	To establish principles applicable to the various sectors related to the management of the archaeological heritage.
2000	European Landscape Convention (Council of Europe, 2000)	To promote European cooperation for landscape protection, management and planning.
2005	Faro Convention (Council of Europe, 2005)	To recognise the right to cultural heritage, to its conservation, transfer and public participation,
2006	Ibero-American Cultural Charter (OEI, 2006)	To foster cultural cooperation between Ibero-American countries and advance the knowledge of their cultural wealth through the improved circulation of the region's cultural assets and products.
2017	European cultural heritage strategy for the 21st century (Council of Europe, 2017)	To share good practice online with the main threads of the strategy: promotion and social participation, sustainable economic and territorial development and contribution to research and education.

Table 3. Participatory management. Main milestones cited in the text. Prepared by the author.

These components interact with each other by way of various targets and recommendations, and although the strategy deploys a good number of measures related to what is called the social component, there is a specific recommendation (S5) that proposes the promotion and evaluation of civic participation practices and procedures through the following actions:

– Identification of existing barriers to civic participation and proposal of solutions
– Evaluation of existing practices to develop civic participation in the governance of the cultural heritage
– On the basis of the above, adoption of procedures to improve participation
– Implementation of new participatory focuses

Mention should also be made here of the *Ibero-American Cultural Charter* adopted by the Organisation of Ibero-American States in Montevideo (Uruguay) (OEI 2006). This Charter states its purposes, principles and areas of application. It is the principle of participation that reflects the need to establish cross-cutting legislative and institutional frameworks to facilitate social participation in all its forms.

The production of archaeological information is highly specialised and does not invite participation to the same extent as other types of heritage with which people interact more actively in their daily life, especially the built and intangible heritage. In general, people are passive receivers of archaeological information mainly offered through training activities, the Internet, visiting excavations open to the public, exhibitions and museums, and scientific publications. However, in parallel with this, the use of digital media enables the generation of content that is disseminated through a variety of social stakeholders on blogs, social networks, collaborative applications, websites, etc.

It is also difficult to construct collaborative inter-institutional environments between the different administrative levels and/or levels of competence for the production of digital contents. How can richer interaction be driven between academia, the administration, the professional sector and the rest of interested society?

There are a few collaborations promoted by the public institutions in the field that this work is focused on, the production of cultural heritage information, in general, and archae-ological information, in particular. Those of the autonomous governments of the regions of Aragon and Andalusia, the National Archaeological Museum and the Autonomous University of Barcelona can serve as examples.

The Aragon Cultural Heritage Information System (http://www.sipca.es), sponsored by the Government of Aragon, offers authoritative information produced through a network of institutional collaboration that includes two provincial councils and 21 districts (Boleá 2012). Interinstitutional collaboration is well consolidated but the system involves mainly architectural and intangible heritage assets and provides very little archaeological information.

In May 2020, the Andalusian Government's Department of Culture and Historical Heritage launched the Network of Andalusian Cultural Heritage Informants to strengthen institutional and civic collaboration in the production of information (IAPH n.d.). Despite this initiative being recent, cultural and academic institutions, associations, companies, professionals and other interested parties have already joined the Network and, after being validated by the IAPH, the information is added to its Digital Guide. The following can be named among the group of non-institutional social stakeholders in the Network directly related to the archaeological heritage: the *Unidos por Turaniana* platform, the *Amigos de la Alcazaba de Almería* Association, the *Malache Arqueología* Association, the *Viaje a la Prehistoria* Association and the Casa Bonsor in *Mairena del Alcor*. So, the IAPH offers a platform for the dissemination of local heritage and the preservation of the contributed data, which, in turn, enables more up-to-date information to be offered to the interested population as a whole.

Other innovative initiatives in this line are the formalisation of collaborations between Wikipedia and institutions as the National Archaeological Museum (Ojeda and Tramullas 2019) or the Autonomous University of Barcelona (UAB 2015) to spread knowledge and improve the quality of the archaeological information in the free and collaborative encyclopaedia.

Sometimes it is social stakeholders who bear no direct relationship with regulated heritage management or research who, individually or collectively, lead actions for the generation of a diverse range of archaeological information. Such are the cases of *Patrimonio Galego* (http://patrimoniogalego.net/) *Cas-*

tillosNet (https://www.castillosnet.org), *Arte Sureño* (http://www.arte-sur.com/) *Viajando entre piedras* (https://www.viajandoentrepiedras.com) and *Arqueoblog* (http://arqueoblog.com/), among many others.

However, there is still a long road ahead. Social participation in the field of archaeology is not an easy task in the traditional work dynamics of the discipline and, as in other areas of knowledge requires some deep thought to analyse who the people are who are participating, what they are participating in and why, so that Open Archaeology might also be ethical and inclusive and not simply the switching of responsibility from the public administrations to the population as a whole, given the former's lack of resources to perform the functions that they have been mandated, nor a simple exercise to disseminate and spread information (Guillen *et al*. 2009; Fredheim 2020; Jiménez-Esquinas 2020).

Although with difficulties, public participation in archaeology is becoming more and more common, its visibility increasing in the academic field, as can be seen, for example, in the edition of a special volume dedicated to this subject in the *European Journal of Postclassical Archaeology* (AA.VV. 2019). To expand along these lines, alliances need to be forged to generate social interest, uphold the discipline and commit the community to its heritage, as when alliances have been formed in a diverse range of contexts, the result has been positive (Simpson 2008; Tait *et al*. 2013; Almansa 2014; Ayán 2014). Nevertheless, the context has to be analysed at each location, as must the area of management that can be shared and the type of participation that is possible and viable and can be engaged in each case. It must never be forgotten that knowledge production from archaeological interventions implies the destruction of the physical record of the past so should be addressed with the full guarantee that the data will be scientifically processed. Social participation is just as necessary a part of the production and management of archaeological information as are the specialists in archaeology who have the responsibility to lead knowledge production and its appropriate transfer.

6. Conclusions

It seems that there is currently broad acceptance of the fact that public sector data have become a key resource which, according to some approximations, by 2013 were already generating some 40 billion Euros per year in Europe (D'Andrea 2013). There is only a limited number of studies that focus on the demand for open archaeological contents and the impact that it produces. The Archaeological Data Service has made some estimates as to the value of the service it provides. These studies have confirmed that the benefits greatly outweigh the operating cost and that the service is greatly appreciated by the archaeological community and other agents who make use of it (Beagrie and Houghton 2013; Richards 2017).

No similar studies have been carried out in Spain, although there have been some that have focused on the reuse of public sector open data in general. These studies highlight the fact that the most common uses made by those who reuse these data are culture related, although the applications produced with an associated business model are mostly related to health, the environment and transport (Abella 2019).

For its part, in 2016 the IAPH estimated the impact of the information that it makes publicly available through the Digital Guide of the Cultural Heritage of Andalusia. At that time, the information could only be accessed for consultation. The conclusions of the study were published —along with all the information on which it was based— in the IAPH's repository of digital assets (Fernández *et al*. 2016) and showed that there was sustained growth in the references to the said information in the scientific and cultural and educational heritage management spheres from 1995 to 2015, as well as in the way that the public, in general, rated its use. This growth became more evident during the last five years that were analysed.

The volume of academic archaeological content on open access platforms, normally in .pdf format, is enormous. An estimation of its use can be made on the basis of metrics of citations in scientific production and they underpin today's process of scientific research. However, the same is not true of open data, few of which have been published and the reuse of which is almost insignificant (Huggett 2018; Kansa and Kansa 2018). As J. Hugget (2018) states, and despite the fact that there does not seem to be a consensus regarding optimal levels of data reuse, the apparent low level of reuse of archaeological contents preserved in

digital repositories may well cast doubts on their usefulness in terms of the resources invested in their production, processing and in the progress (or lack thereof) towards taking them available to the wider public. One might, therefore, wonder what would have happened if documents in historical archives had been destroyed once their original use was no longer called for. Data reuse may still be difficult, but once the technology for their preservation, sharing and reuse is known, they must be kept available to advance knowledge in the relatively near future, when a new generation of better-educated professionals can take on the task with improved knowledge and technological skills.

Although the availability of archaeological data is increasing progressively, the speed of the paradigm change for their release and reuse is not improving in parallel with their production in either the heritage management or academic worlds, as has been stated in some works (Whysel 2015). However, the success of some of the cited initiatives would not only represent significant progress in archaeological research with new opportunities for development, the ability to compare results and to make the resources invested in them cost-effective (Kansa and Kansa 2013), but the qualification of preventive and urgent archaeological interventions could also be planned in an increasingly effective way in line with improvements to the efficiency of access to pre-existing information (D'Andrea 2013).

However, for broad-spectrum Open Archaeology to be put into practice, it has to be incentivised through public initiatives linked to, for example, the dissemination of already existing data, knowledge of which can, on occasion, be seen to be very limited (Costa *et al.* 2012; Agenjo-Bullón and Hernández-Carrascal 2019), to it being valued in processes to award competitive projects in tenders and the promotion of actions to drive its reuse. Encapsulated knowledge, knowledge to which access is restricted or which is difficult for the public at large to understand would not seem to be the best path to sparking an appreciation of the archaeological heritage, having its value acknowledged and furthering its preservation as a scientific, cultural, social and economic territorial asset.

All this leads to the conclusion that in the discipline of archaeology, in the medium term, progress will have to be made in the provision of open and interconnected data and structured information, in the generation of knowledge distributed and managed in a shared fashion and in driving competitive excellence research with free access and open data as another parameter of quality to complete the cycle. In order to achieve this, it would be desirable to improve the quality and standardization of the metadata, so that datasets can be more easily related, which still depends on the investment of time and human resources dedicated to this task. The *Data Archiving and Networked Services* (https://dans.knaw.nl) of the Netherlands can be an example in this regard, as it defines clear guidelines, also for the digital exchange of archaeological data. At the same time, it might be necessary to start bringing professionals in the fields of documentation and social mediation into the research teams, in the same way that collaboration with professionals in physical anthropology, geology, chemistry and many other disciplines and areas associated with the natural sciences already seems to have been accepted.

EPILOGUE: One example of an extraordinary achievement that science can accomplish through information sharing has, without doubt, been to obtain a COVID-19 vaccine in an extremely short period of time. Perhaps, as the British daily newspaper *The Guardian* reported in December 2020, this experience has changed science forever (Sample 2020).

Acknowledgements

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