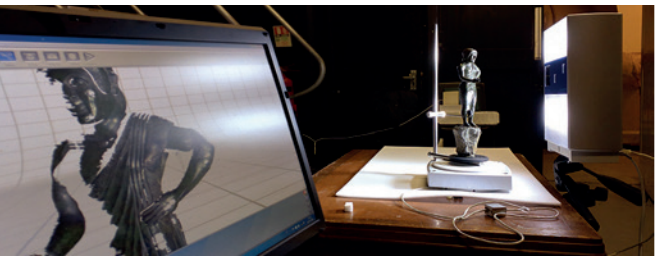
ARIADNE plus

THE ARIADNE IMPACT

EDITED BY JULIAN RICHARDS AND FRANCO NICCOLUCCI





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Budapest 2019

The research presented here was funded by the European Commission under the FP7 Programme ARIADNE project, contract no. FP7-INFRA-2012-1.1.3-313193, and under the H2020 Programme ARIADNEplus project, contract no. H2020-INFRAIA-2018-1-823914. Other national or international funding for this research is acknowledged in the relevant sections.

The present publication was funded by the European Commission under the H2020 Programme, as part of the ARIADNEplus project, contract no. H2020-INFRAIA-2018-1-823914.
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Copy editor: Kyra Lyublyanovics

Desktop editing and layout: Zsuzsanna Kiss

Cover design: Móni Kaszta

ISBN 978-615-5766-31-2

ARCHAEOLINGUA FOUNDATION
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www.archaeolingua.hu
Managing Director: Erzsébet Jerem

Printed in Hungary by Prime Rate Kft.

Contents

The Zbiva Web Application: a tool for Early Medieval archaeology of the Eastern Alps

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Abstract

'Zbiva' is a research database for the archaeology of the eastern Alps and its surrounding regions in the Early Middle Ages. Its inception in the early 1980s was deeply rooted in the scientific research context of the time. In 2016 the database front-end was migrated to the 'Zbiva web application' based on an open source Arches 3.0 platform. Zbiva is a GIS-enabled web application focused on catering to the needs of highly invested researchers. Some of the most important design ideas for the application were informed either by the ARIADNE User Needs report or by discussion with many collaborators within the ARIADNE consortium. The design maxim for Zbiva was to focus on highly motivated and invested users. This was only possible because Zbiva's data top level data search is 'outsourced' to the ARIADNE portal.

Keywords: Early Medieval archaeology; Eastern Alps; web application; database

Introduction

Zbiva (Pleterski and Belak 1995; Kastelic et al. 2016) is a research database for the archaeology of the eastern Alps and its surrounding regions in the Early Middle Ages. Its current front end is the Zbiva web application,[1] a GIS-enabled web application focused on catering for the needs of highly invested researchers. The aim of this chapter is to present the development of the Zbiva web application with an emphasis on the role the ARIADNE project played in the application's design.

Scientific background

Zbiva was designed as a tool to study the so-called Carantanian-Köttlach archaeological culture. This means that – for historic reasons – its chronological focus was on the time from the settlement of the Slavs in the area in the 6th century AD until the end of habitual deposition of grave goods in the 11th century AD. It primarily holds data from the archaeologically relevant region that includes nowadays Slovenia, Austria, NW Croatia, and NE Italy. For comparative purposes it also includes selected relevant sites from neighbouring regions and from the preceding period.

[1] http://zbiva.zrc-sazu.si

The history of Zbiva dates back to 1980 and its inception is deeply rooted in the scientific context of Early Medieval archaeology in the Southeastern Alpine area in particular, and in the Central European tradition of archaeology in general. In order to understand the circumstances a brief history of research is needed (*cf.* Štular and Pleterski 2018).

Research into the Early Medieval archaeology of the Southeastern Alpine area began with the publication of 'unusual enamelled jewellery' found in 1853 by workers digging for gravel at Köttlach in Lower Austria (Franck 1854). When the author of this publication asked himself a series of questions, including who were the people to whom these finds belonged, and when did they live, he set the research agenda for more than a century. The number of similar finds rapidly increased thus revealing the full extent of the phenomena.

The main research agenda until 1980s was to define the archaeological culture that the material belonged to, as well as its chronological and ethnic definition. Dating these artefacts to the early medieval period was soon clear. However, in accordance with the cultural-historical understanding of archaeological artefacts (*cf.* Jones 2003), a controversy arose regarding the ethnicity of the people to whom this enamelled jewellery belonged. Some scholars assumed that it belonged to the Slavs, others disputed that it was exclusively Slavic, and others saw the same artefacts as evidence for the early medieval presence of Germans in the Eastern Alps. (For the period until the First World War see Pleterski 2001; for distinctively different understanding during and immediately after the Second World War see Dinklage 1941a; 1941b; 1941c; 1943 and Korošec 1947). Over time terms Carantanian – after the connotations with the early medieval Duchy of Carantania (Schmid 1913) – and Köttlach – after the site of first discovery – were coined into *terminus technicus* Carantanian-Köttlach (archaeological) culture. In historiography this population was termed Alpine Slavs (Grafenauer 1954; *cf.* Kahl 2002). The Early Medieval archaeology of the region, its sites (242 at that time) and the artefacts were presented by P. Korošec (1979), who indicated chronological and cultural differences within the Carantanian-Köttlach culture. Almost simultaneously Jochen Giesler's chronological essay on the same material proposed a very different chronological interpretation (Giesler 1980).

Subsequent discussion was only driving the protagonists further apart, which suggested that the entire scientific discourse needed to be built anew on fresh foundations. And it was to this end that the concept of the archaeological database Zbiva was envisaged at ZRC SAZU[2] in 1980 under the lead of A. Pleterski and M. Belak. The database took its first digital shape in 1987 (Zbiva v1) as a closed system based on a single PC. An early demonstration of the database's potential was an analysis of Early Medieval church organisation (Pleterski and Belak 1995). The web-based version (Zbiva v2) was deployed in 2000. Due to the technical limitations only sites and the

[2] Znanstvenoraziskovalni center Slovenske akademije znanosti in umetnosti (Research Centre of Slovenian Academy of Sciences and Arts). The work on both Zbiva and ARIADNE took place within the Inštitut za arheologijo (Institute of Archaeology).

bibliography were accessible. In 2016 a full-blown GIS-enabled web application featuring the entire data set (Zbiva v3) was released.

A key strength of this data set is that since its launch Zbiva is regularly (monthly) updated by scouring the relevant literature. Access to the latter is based on the systematically built and sustained literature exchange network between ZRC SAZU and all of the major institutions contributing to the topic. At the time of writing Zbiva holds data on 2944 sites from the core region and a further 435 comparative sites.

This is a significant departure from the 242 sites discussed by Korošec and Giesler in 1979 and 1980. The difference is in part due to the increase in known sites published after 1979 and in part the result of the long-term systematic approach to data collection. To be precise: 50.6% of sites in the current Zbiva database have first been published in or prior to 1979. This means that a very diligent and capable researcher using a classical approach in 1979 was able to gather data on 14.1% of sites known at the time. By extension, it can be conjectured that a diligent researcher using the same approach nowadays would be working with less than 500 sites, whereas Zbiva at the time of writing enables an analysis of 3379 sites.

Zbiva v3

The trilingual (Slovenian, English, German) Zbiva database is an aggregation of:

- a sites database
- a graves database, and
- an artefacts database.

The *Sites database* (*Figure 1*) includes spatial information and site type, chronology, and bibliography. This being a research database the bibliography is the most important and also most diligently curated data set. At a first glance a bibliographic collection may seem obsolete due to the abundance of online resources devoted to scientific literature. However, this is far from true since (i) most of the relevant books and periodicals are still only published in print or are behind a paywall (ii) a significant portion of the bibliography stems from old publications that are not likely to be digitised in the foreseeable future and, most importantly, (iii) the whole bibliography has been enhanced with tagging using a controlled vocabulary (e.g. flat graves, hoard, church; monograph publication, article, report; head-circlet, necklace, ring).

The *Graves database* (*Figure 2*) comprises data on individual graves from selected cemeteries. Each grave is described by selected criteria (e.g. grave features level 1 and 2, body features level 1 and 2, dimensions, orientation, stratigraphic relations), free text and images. Currently only six cemeteries out of 1354 are included. However, by far the largest relevant cemetery in the region (Župna cerkev in Kranj, Slovenia) is included in its entirety and the second largest (Ptujski grad, Ptuj, Slovenia) is to be added in 2019. The graves database was not envisaged to provide comprehensive coverage of all published cemeteries but rather as a tool to be used for cemeteries

under investigation. As such it is open for contributions and can be used as a research tool by all researchers with suitable dataset.

The *Artefact database* is similar to the graves. Free text description and images are supplemented by typological determinations (only for pottery, jewellery and knives). This portion of the database currently includes data on over 10,000 individual artefacts from sixteen sites although it was also not designed to provide comprehensive coverage.

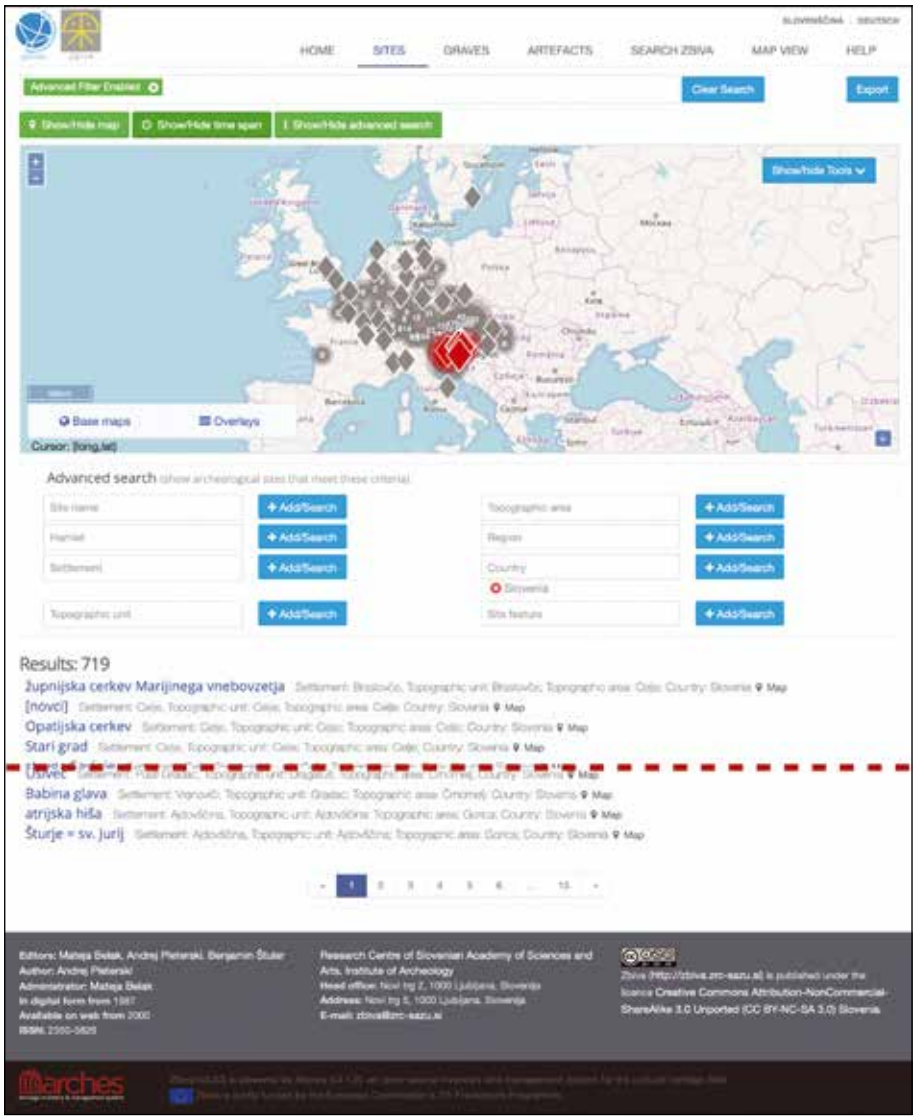

Figure 1: The Zbiva web application (English interface), Sites; results for advanced search term 'Country – Slovenia' are shown in red

The Zbiva web application is based on the Arches 3.0[3] open source inventory and data management platform. The Arches project originated in 2004 when the Getty Conservation Institute and World Monuments Fund formed the Iraq Cultural Heritage Conservation Initiative. Due to the security uncertainty the project was moved to Jordan and in June 2010 development of MEGA-Jordan was completed. This is a web-based, bilingual geospatial information system built with open-source tools designed to serve as an archaeological site inventory and management system. In April 2011 a prototype of MEGA-Iraq was made available but never deployed. During the development of the MEGA system many heritage organizations around the world stated their interested in using the system. This led the Getty Conservation Institute and World Monuments Fund to develop a user-friendly, low-cost, web-based geospatial information system designed to help inventory and manage all types of immovable heritage, including archaeological sites, buildings, structures, landscapes, and heritage assemblages or districts. In June 2011 the development of Arches as an open-source project began and Arches 1.0 was deployed in 2013. Zbiva is based on the third version (3.0) and the current version since February 2019 is 4.1.4 (Kastelic 2015; Kastelic et al. 2016; cf. Lee Enriquez, Myers and Dalgity 2018).

Based on experience with the MEGA project and extensive research on best practices and standards the following guiding principles have been set for Arches (Kastelic 2015):

1. *Standards*. The system must be based on internationally adopted standards for information technology, heritage inventory, and heritage data management (e.g. the CIDOC CRM). The incorporation of such standards is necessary for the creation of a generic system for heritage inventory and management anywhere in the world and promotes sharing and longevity of data regardless of inevitable technological advances.
2. *Accessibility*. To allow for maximum accessibility the system must be web-based and as end-user friendly as possible.
3. *Efficiency*. As an open-source system it has to be provided free-of-charge and at the same time it must provide support for long-term sustainability.
4. *Upgradability*. The system must be modular so that it can be easily tailored and upgraded. One of the key features in this regard is multilingual support.
5. *Security*. The system must allow for different levels of access, e.g. open, closed or any combination in between.

The existing features of Arches obviously set the frame for the Zbiva web application but upgrades enabled us to tweak the application according to our needs. The design maxim envisaged for Zbiva was that the application is to be used by highly motivated and invested users. Since Zbiva's data on sites is included in the ARIADNE portal the accessibility for top level – and hence less invested – research was 'outsourced' and therefore not our first priority. However, once assured that Zbiva offers data relevant for her/his research the researcher becomes committed to drill deeper into the data. This means that Zbiva's design priorities need not be simplicity,

[3] http://archesproject.org

speed and visual allure. Rather, we were able to focus on a fully commited user solving specific research questions. In other words, we were designing the application based on our own experience and use case scenarios.

A practical example of this design approach is the depiction of search results (*Figure 1*). By default the Arches platform is set to return five hits per page and as a consequence the operation only takes a fraction of a second. In addition, the results are presented in an expanded font that is pleasing to look at. However, in our use cases a typical search would easily return a hundred or even hundreds of relevant results, e.g. female graves with a finger ring. The aim of the researcher is not necessarily to narrow the search scope but to inspect all of the results. In order to better facilitate such scenarios Zbiva now returns fifty results per page in a more condensed font. Thus some of the visual appeal and speed has been sacrificed for usability in a realistic use case.

The following are mayor upgrades developed for Zbiva (Kastelic et al. 2016):

- additional multilingual support for data import
- support for new document types (sites, graves, artefacts)
- advanced search capabilities tailored for structured search (separate search for each document type, multi-level search, search according to the dimension using limiter from … to)
- automated import from the central MS Access database into the Arches environment
- several map extensions (export, import, enlarge window, search within polygon/radius/distance)

The most important feature of Zbiva from the user's perspective is its twin search engine combining elasticsearch[4] and SQL since Zbiva is a relational database. The strength of a relational database structure, from the perspective of the intended Zbiva user, is the ability to efficiently drill into the data by multi-level search queries enabled by an upgrade, e.g.

- body feature – level 1: grave goods
- body feature – level 2: ring

Another huge advantage of this data structure is that after the initial investment into the translation of controlled vocabulary the database is able to operate in three languages.

However, data input in this relational database with controlled vocabularies is time-consuming since the data must be interpreted prior to the input. This is, at least in the case of Zbiva, an assiduous scientific process rather than a mechanical data input. In addition, the search in relational database is most efficient if the user is familiarized with the database structure.

To mitigate these downsides most of the entries in the Zbiva database also include descriptive fields, the upkeep of which is more time-efficient. This free text can be

[4] https://www.elastic.co

searched using the elasticsearch engine. The results are less predictable and will often return a larger number of results with a lower degree of relevance. This search is also limited by the language of the free text that is currently mostly Slovenian. Such usage can be described as unstructured search, e.g. 'prstan' (*en.* finger ring).

Perhaps the biggest improvement of the Zbiva web application over the preceding version of is that it is GIS-enabled, i.e. for the first time it is equipped with map tools. Any search can be spatially tailored. For example, any search can be limited within a user-defined polygon or within a set distance from a designated point or line. In combination with a time span slider Zbiva has become a fiercely effective tool. Some of the most common types of search in archaeology are a combination of spatial and chronological attributes, e.g. finding settlements within a 50km radius dated to the 9th century. Without the access to the data held in Zbiva such search takes weeks. But more importantly, even using the Zbiva database (but not the Zbiva web application) in combination with desktop GIS tools such a search takes considerably longer than in the Zbiva web application where it can be done in under a minute.

Use cases

It is not the intention of this chapter to delve into the particularities of Early Medieval archaeology. However, two use cases will be briefly presented to demonstrate the capabilities of the Zbiva web application.

The first example is an analysis of the graves of the Župna cerkev in Kranj cemetery. This is a large cemetery with 2945 medieval and post-medieval graves excavated. Close to 1000 of those are Early Medieval graves (overview in Štular and Štuhec 2015), which is as many as the next three largest cemeteries in the region combined (*cf.* Štular and Pleterski 2018 with bibliography). The analysis of the site has been hindered so far by two factors. Firstly, it was excavated in numerous expeditions between 1953 and 2013 which makes the data sets very heterogeneous (*cf.* Štular and Belak 2012a; 2012b; 2013; Belak 2013; 2014; Sagadin and Belak 2014). Secondly, the sheer quantity of data and density of burials (at one point reaching 19 burials per square metre) demands the use advanced spatial analysis (*cf.* Achino et al. 2019). Obviously, an in-depth analysis of such a site can only take place within a long-term dedicated research project. Such a project is underway (Pleterski, Štular and Belak 2016; 2017; Pleterski, Štular, Belak and Bešter 2019) and as a part of this project data on individual graves has been added to Zbiva.

Earlier researchers, whose engagement preceded the advent of digital tools, struggled to answer a seemingly simple research question: was the spatial distribution of Medieval burials static or dynamic?

To answer this question the general search and mapping capabilities of the Zbiva web application have been employed. First the distribution of a typical Early Medieval head-jewellery (head circlets) was mapped (*Figure 2a*). To demonstrate the extent of the High Medieval and Early post-Medieval cemeteries several typical artefacts made

of brass have been mapped (*Figure 2b*). The comparison of the two distribution maps clearly demonstrates the much larger extent of the Early Medieval cemetery. In further refinement a selection of typical Early Medieval artefacts have been mapped. The first is a type of head circlet typical for the first half of the 9th century AD (*Figure 2c*) and the second group are two types typical for the late 10th and 11th centuries (*Figure. 2d;* cf. Pleterski 2013). While both the earliest and the latest types of Early Medieval female jewellery are distributed evenly throughout the cemetery there is a discernible difference between the distribution of the two latest types. This clearly demonstrates the dynamics in the process of selection of burial plots within the cemetery other than purely chronological factors.

Such quick insights into the cemetery's dynamics are by no means sufficient for any sort of final interpretation and can only be seen as a starting point for in-depth research. This is exactly how the project team is using the Zbiva web application: as a tool for hypothesis testing. However, the depth of analysis enabled by the Zbiva web application exceeded our expectations. It is especially noteworthy that the use case above has been performed on non-structured data, i.e. on free text descriptions of individual burials taken from digitised archives (Štular, Belak 2012a; 2012b; 2013; Belak 2013; 2014; Belak, Sagadin 2014).

The second use case demonstrates the use of the Zbiva web application as a planning tool. As mentioned, the backbone of Zbiva is data on more than 3000 sites. One of the most exciting expectations from the Zbiva web tool, when it was designed, was the promise of an insight into the chronology of settlement dynamics. Once the application was operational it was a simple task of using the combination of time span and map to compare spatial distributions. An example of this is a comparison between the spatial distribution of cemeteries in the 8th and 10th centuries. In this period it is known that burial shifted from cemeteries without a church to cemeteries with a church (Pleterski and Belak 1995). Alas, the result was inconclusive since no discernible pattern is noticeable (*Figure 3*). Further examination confirmed that the underlying chronological data is simply too coarse to answer this question.

This was, however, not a failure of the application. Rather, the Zbiva web application enabled us to pinpoint the weakness in our dataset. This revelation was turned into a convincing research question and ultimately in the successful bid for a € 600,000 research project. In other words, the Zbiva web application proved itself to be an invaluable tool for assessing the data quality of the Zbiva database.

Conclusion: The impact of ARIADNE

Just as the scientific background was important for the inception of the Zbiva database in the 1980s so was ARIADNE important for the creation of the Zbiva web application: not necessarily the only reason but surely a key influence. When ZRC SAZU joined the ARIADNE project in 2011 it had neither a vast experience in big European projects nor an archaeological IT department to speak of. It was therefore our primary intention to keep our heads down and eyes open. However, within the

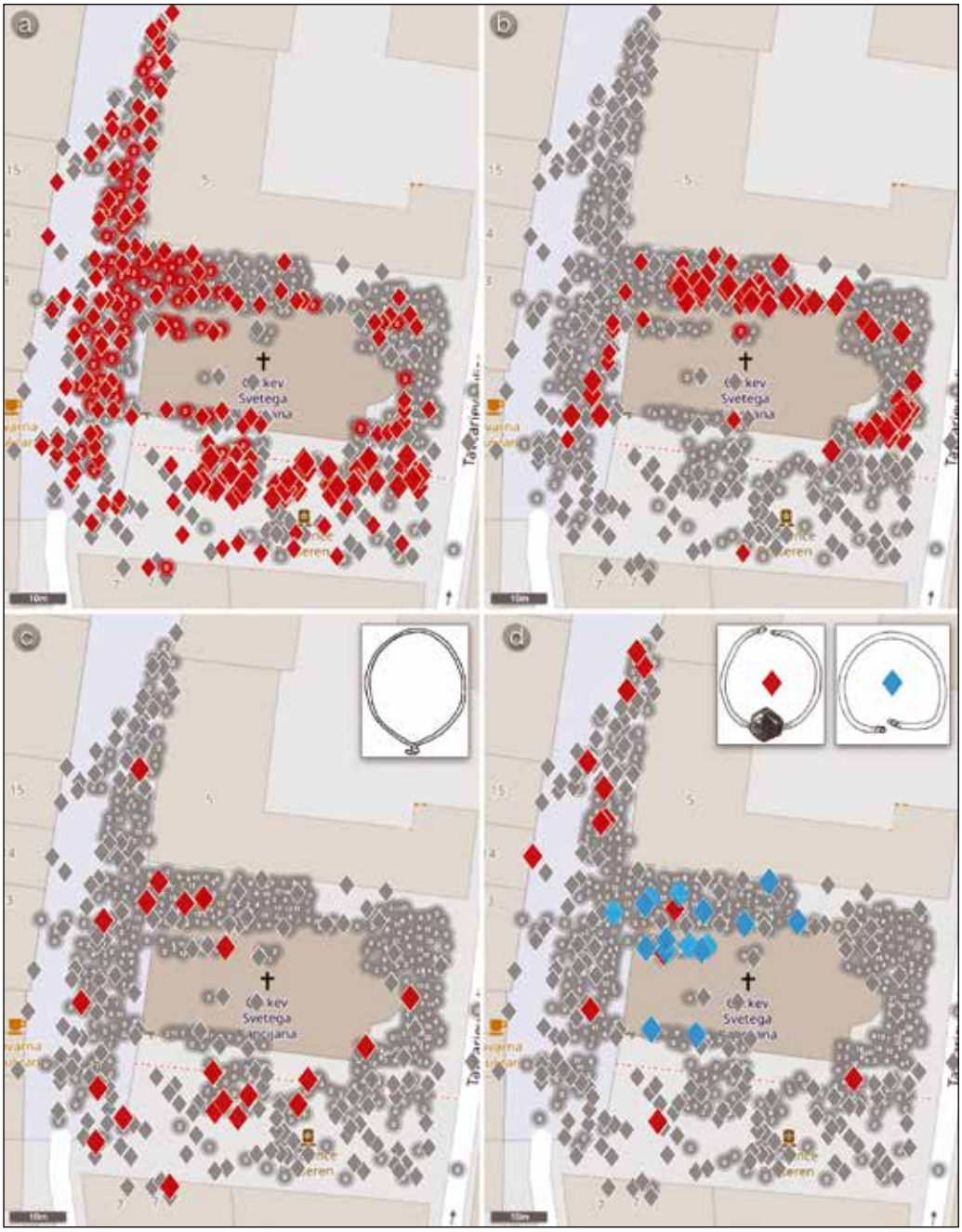

Figure 2: Zbiva web application search results on a Župna cerkev in Kranj cemetery: a – head circlets typical for Early Medieval jewellery; b – brass jewellery typical for late High Medieval and early post-Medieval period; c – specific type of head circlet with two hooks (see inset images) typical for 8th/9th century AD; d – two specific types of head circlet with double thickenings (see inset images) typical for 10th/11th century AD

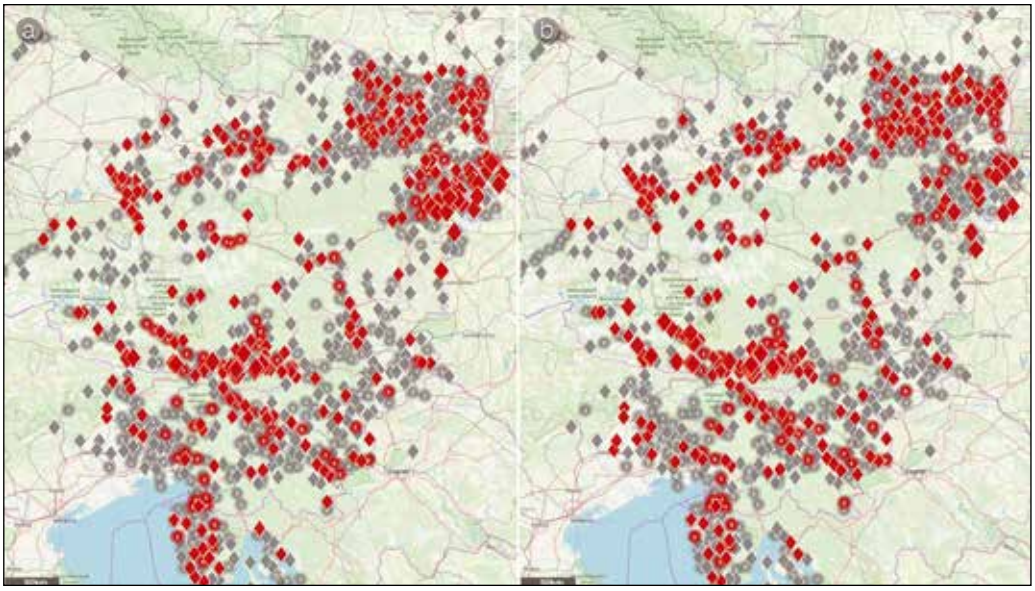

Figure 3: Zbiva web application search results on sites: a – 8th century AD cemeteries; b – 10th century AD cemeteries

first day of the project's kick-off meeting it became clear that we are not alone in this preconception. The consortium has been built from two types of partners that, for the purposes of clarity, the project's principal investigator Franco Niccolucci divided into the 'technical partners' and the 'content providers'. The former are some of the biggest European institutions in the field of digital archaeology and the latter are a selection of the most prominent archaeological institutions in Europe. It was as if a huge burden has been taken off our shoulders when we realized that we were not alone in the situation that could be best described as technologically challenged. As a matter of fact, ZRC SAZU at the time was probably a good example of an average institution as far as digital infrastructure in the humanities was concerned. And this, indeed, was the vision behind ARIADNE in the first place: to bring together the best and brightest in the field of digital infrastructure in archaeology and the best and brightest in the field of archaeology.

For the remainder of ARIADNE, work on the project was a pleasant experience, but more importantly, a hugely rewarding one. The main stated task of ZRC SAZU in the ARIADNE project was to make all the necessary preparations in order to include ARKAS and Zbiva in the ARIADNE portal[5] (*cf.* Štular, Niccolucci and Richards 2016, 160). During each stage we were forced to learn and adapt which greatly improved our understanding of the role of digital infrastructure in 'everyday' archaeology. With this we began to better understand not only our weaknesses but also our strengths.

[5] http://portal.ariadne-infrastructure.eu/

The biggest strength of ZRC SAZU in this regard is systematic gathering of selected scientific data for the past four decades. As with most archaeological research institutions in a Central European milieu ZRC SAZU's Institute of Archaeology is internally organised according to archaeological periods and the focus of our research is to publish research in scientific journals and monographs of the highest quality. However, since the outset in 1947 there was always an additional task of systematic collection of data (Pleterski 1997). The work of the first generation of post Second World War archaeologists in Slovenia culminated in an atlas of archaeological sites comprising almost 5000 entries (ANSL 1975). The work of the next generation, apart from continuously upgrading the data set, was to migrate this data first into a digital and then to the web-accessible format. This was implemented at ZRC SAZU as ARKAS (Archaeological Cadastre of Slovenia).[6] The other archaeological database of note at ZRC SAZU is Zbiva. Both these data collections are perhaps best described as 'slow data', as opposed to 'big data', emphasizing 'thoughtful digital curation' instead of 'quantity trumps quality' (Kansa and Whitcher Kansa 2016; Huggett 2019; *cf.* Huggett 2015).

Throughout the duration of ARIADNE the same project team at ZRC SAZU has also been deeply involved in a project analyzing an Early Medieval cemetery. The necessities of the latter coupled with an exchange of ideas and project results taking place within ARIADNE gave birth to the idea to elevate an antiquated database Zbiva (v2) into a modern web application. The third piece of the puzzle was a computer scientist, M. Kastelic, who introduced the Arches platform to Slovenian archaeology (Kastelic et al. 2016).

Most of the design ideas behind Zbiva, which elevate Zbiva above a simple implementation of the Arches platform, were informed either by the ARIADNE User Needs report (Selhofer and Geser 2015) or by discussion with our many collaborators within ARIADNE. The most important contribution of ARIADNE to Zbiva, perhaps, was that it enabled us to acquire an overview of the digital archaeology landscape in Europe. This led us to realistically position ourselves in that landscape and, as mentioned above, to realize our weaknesses and our strengths. While we will probably never spearhead technological developments we can employ the ever emerging new digital tools to create added value that on occasions can rise to be second to none.

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[6] http://arkas.zrc-sazu.si

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