

NURNET - GEOPORTAL

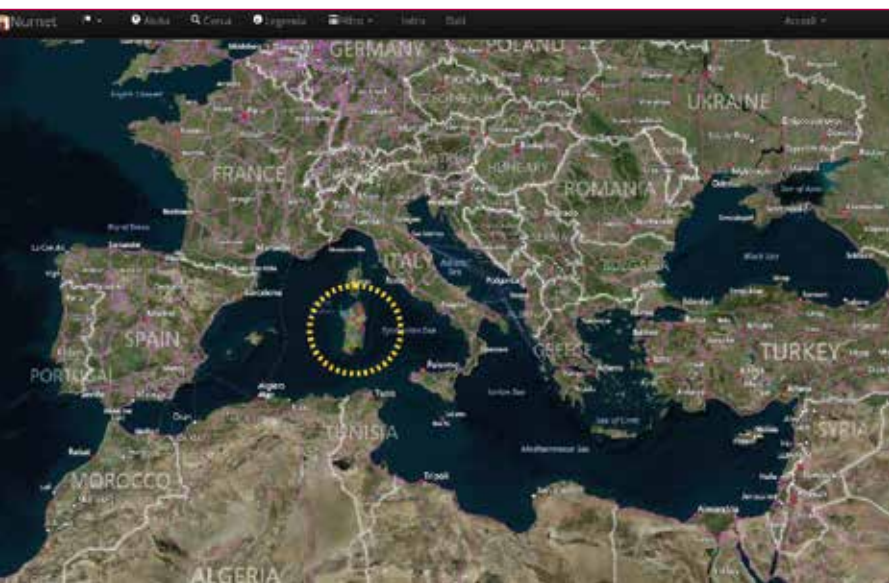


Fig. 1 - The island of Sardinia in the centre of Mediterranean basin.

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The scope of this paper is to explain how the Geoportal Nurnet (net of Nuraghes, the typical Sardinian building from the Bronze Age) has been developed to manage, share and promote the Bronze Age culture in Sardinia, identified in the Pre-Nuragic (3200–2700 BC) and Nuragic (up to the 2nd century AD) civilization.

A cultural heritage landscape is defined geographical area of cultural heritage significance that has been modified by human activities and is valued by a community. A cultural landscape involves individual heritage features, such as structures, spaces, archaeological sites and natural elements that together form a significant type of heritage form, distinctive from that of its constituent elements or parts (Ontario Heritage Trust, 2012).

The promotion and protection of cultural heritage landscape are an inseparable binomial. Thanks to sophisticated programs and the web, the main goals of cultural inheritance conservation and the accessibility to the historical knowledge are easier than before. It is very important to make data available to the public and/or to help the production of new knowledge. For this topic, CRS4, by means of GIS, developed the Geoportal Nurnet. Here, the users may have an active role improving the quality and quantity of existing data. A mobile app has been designed to run on Android smartphones and allow the user to get information also when the device is offline. As a main goal, Nurnet wants to empower the identity link between local population, the relative cultural heritage landscapes and the awareness of their different possible interpretations; this would be impossible to reach without a proper data collection: the philosophy of the project is working with open GIS data. Other two objectives aim to provide useful information to mobile application via API (Application Protocol Interface) and to provide new information and feedbacks from tourists.

THE CHOICE OF A GEOPORTAL TO PRESERVE/PROMOTE SARDINIAN HISTORY

The Nuragic civilization developed in Sardinia from the Bronze Age (18th century BC) to the 2nd century AD. The name comes from the most distinctive expression of their architecture, the tower-fortresses, ‘nuraghes’ (Fig. 1).

It is estimated that there are about 8000 Nuraghes, more than 2400 Domus de Janas (literally “house of the fairies”, pre-Nuragic chamber tombs) have been discovered, more than 50 holy wells, 800 giants’ graves, more than 300 menhirs, and 78 dolmens (https://en.wikipedia.org/wiki/Nuragic_civilization; Lilliu 2006; Dyson and Rowland 2007).

The use of digital map libraries and so called ‘geo-portals’ as tools for the conservation of cultural heritage is relatively new (Fernández-Wytenbach et al. 2007; Cuca et al. 2012; Karabegovic et al. 2012) but it is already giving positive results, demonstrating the multiple advantages of the Web Map Services (WMS) (Cuca et al. 2013).

The creation of the geoportal Nurnet was aimed at several benefits: a more accurate database of the Nuragic archaeological sites of Sardinia, facilities to retrieve internet information concerning this topic, make use of the strengths of Participatory GIS (PGIS) and Crowdsourcing, so providing local governments with a concrete base on which to plan and set up activities to protect and promote the historical heritage, improving services for tourists and visitors.

The Nurnet Geoportal, accessible via the web and provided with functionalities allowing citizens, tourists, associations, institutions an interactive access to the data in a PGIS perspective, has been created as a tool for the management and sharing of knowledge about the Nuragic and pre-Nuragic cultural heritage of Sardinia. Through the portal it is possible to visualize all the elements in the map, consult information regarding selected elements, let confirmed users modify the current information, and add new elements (nuraghes, menhirs, giant’s graves, etc.). It is distributed with Creative Commons Attribuzione 4.0 Internazionale Licence.

WEBGIS AND CROWDSOURCING

The use of WebGIS and crowdsourcing for research is a new practice, but it is gaining in popularity given the facility in

collecting and cross-checking data (Ballatore and Bertolotto 2011; McCall et al. 2015). It has been shown to be extremely useful in monitoring processing in several fields: vegetation cover (Guidry 2011), collecting and recording local names for rural areas (Rampl 2014), promoting environmental awareness and change (Spanu et al. 2015), and providing timely data that may otherwise be unavailable to policy makers in soil and water conservation management (Werts et al. 2012). The case study of Nurnet presents multiple reasons supporting the use of these technological resources to reach the main goal of the promotion and protection of cultural heritage in Sardinia. Firstly, there is an absolute need to collect better information in a territory where numbers and data are still imprecise.

Data collection of the historical heritage of Sardinia of the Bronze Age is a constant ‘work in progress’; oftentimes the only way to get more information is to elicit local knowledge and gather the ‘historical memory’ of the people, seeking to understand the connections between names and places, that is, the relevant science of “toponymy”, defined by the UNGEGN, the United Nations Group of Experts on Geographical Names, as “Place names as intangible cultural heritage” (UNGEGN 2015).

The people who know the territory most comprehensively and who can provide accurate information are the local people. Through webGIS and crowdsourcing therefore it is possible to collect detailed information about what is called “cultural natural landscape”, testifying to those places that represent the “combined works of nature and of man” (WHC 2015) and embracing a diversity of manifestations of the interactions between humankind and our natural environment. Information collection from local people is needed, in order to record the history and memory of the traditional cultural landscapes (WHC 1972). This cooperation between the two sets of actors, experts and local citizens, leads to another key point that is also one of the key statements of the project: the cultural identity of the local people, which is a component of cultural heritage and its protection. Indeed, while they are helping in the process of information collection, the local participants can rediscover their own roots and keep alive their cultural heritage, cultural landscape and memory (McCall et al. 2015), also making it available to younger generations. Consequently, the preservation and the monitoring of the historical sites also benefit.

Preservation and monitoring

In the operationalization of the Nurnet platform, the processes of preservation and monitoring of the archaeological sites are performed both by experts and local volunteers. Experts collect data and information, record the state of conservation of specific sites, structures and artifacts, monitor the various types of tourism and the expectations of visitors, analyse the impacts of visitors on sites and structures and the risks of deterioration and degradation, and suggest protection measures for the public bodies in charge of conservation.

Local people and tourists contribute considerably to these processes: local people supplement and complement the basic information about the archaeological sites, but also because they live in the locality, they are the first people to recognize the state of conservation and any changes in the sites which require maintenance from technicians; tourists contribute to the preservation and monitoring processes as well, specifically because they have fresh eyes and externally-formed opinions. Because they visit a site for the first time or only occasionally, they notice things from an external (visitor’s) point of view: the state of conservation, comparisons with other places they have visited, hints on how a place might be valued by other visitors, services needed to allow

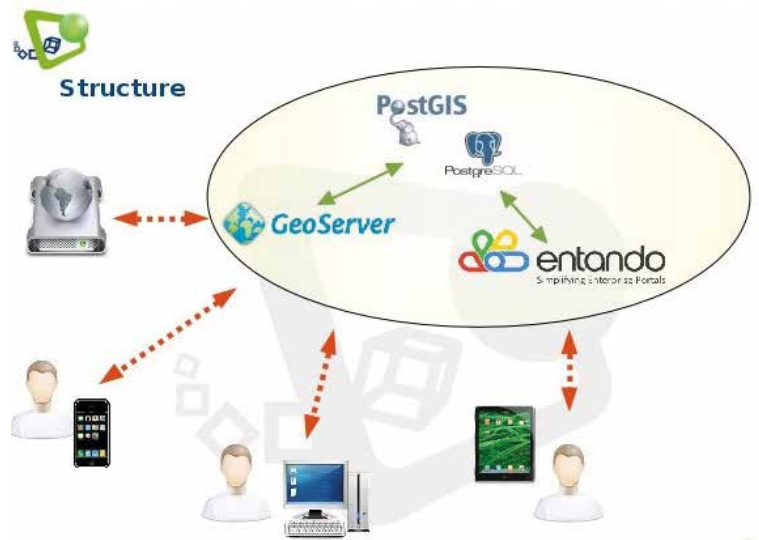


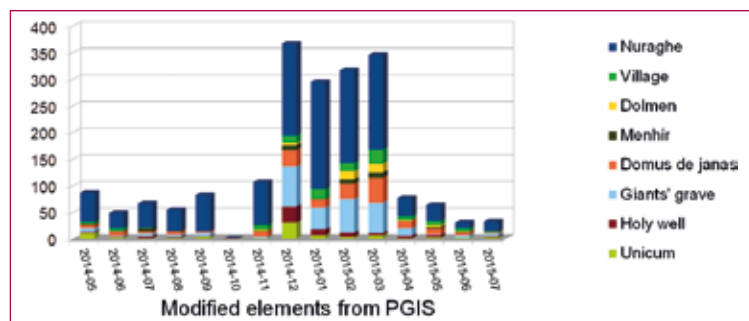
Fig. 2 - Structure of the Web Portal: a CMS based on the Entando platform with the support of the PostgreSQL DBMS and Geoserver for the Web-GIS interoperability.

better access for e.g. elderly people, disabled, children. Tourists are actually the actors perceiving the archaeological site as users of goods and services, so their perception and feedback are extremely significant for protecting and monitoring the historical sites as places of touristic attraction. The Nurnet apps for smartphones can thus contribute to monitoring whilst they are being used for exploring the historical landscape.

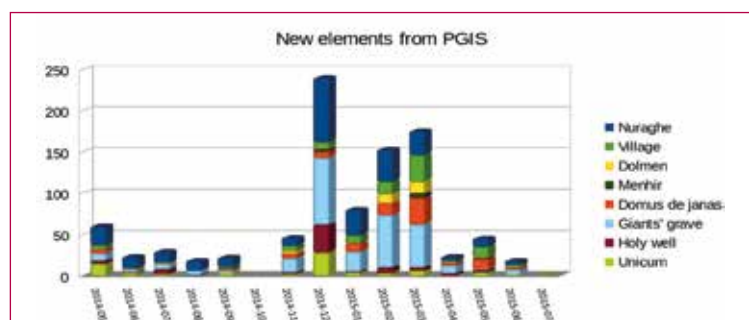
OPEN SOURCE, OPEN DATA AND OPEN SERVICE

Implementation of the Nurnet Geoportal is in line with the “Open source” philosophy - the software used to realize it is open source, and the published data are open data available via open services.

The choice of the “Open” philosophy is derived from the choice of Participatory GIS as the engine of the Geoportal. The participation of local people and visitors in making and sharing the knowledge implies an open infrastructure that is able to involve a large number of people so as to ensure a significant data set.



Tab. 1 - New elements created in the period May 2014--July 2015.



Tab. 2 - Modified elements in the period May 2014--July 2015.

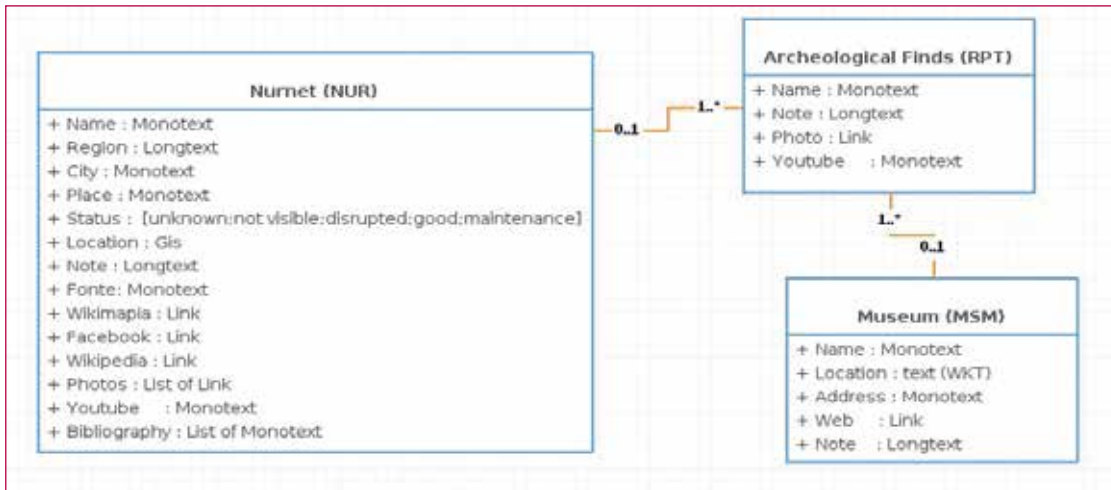


Fig. 3 - Structure of the entities and their relations.

Applying an “open philosophy” approach by itself does not guarantee the quality of the data. For this reason, after their input in the portal by the users - who are also editors - the data items will be validated by an expert before being published. The validation mechanism is similar to that used in Wikipedia for instance, though somewhat more restrictive.

ORGANIZATION OF THE WORK AND STRUCTURE OF THE GEOPORTAL

The idea of a geoportal was born in the beginning of 2014. After a first stage of data collection and project design, it was implemented and published on-line in beta version in June 2014. The interest that this instrument generated was immediate, thanks also to the Nurnet Foundation activities. This indicates that participatory solutions benefit from the direct involvement in data management of local people, local organizations and visitors.

The organization of the work for the development and management of the Geoportal has been structured as following:

1. data collection from all available sources (databases of Regione Sardegna (<http://www.sardegnageoportale.it/webgis2/sardegnamappe/?map=base>) and Wikimapia (<http://wikimapia.org/#lang=it&lat=39.622615&lon=9.225769&z=9&m=b&tag=37157>), cross checking, filtering and cleaning from imprecise data or double records,
2. new data model definition,
3. extraction, transformation and loading of collected data into a geodatabase
4. planning and implementation of the Participatory GIS web instruments
5. deployment of the Geoportal
6. monitoring and promotion

The virtual machine where the system resides has 24GB of ram and 500 GB of disk storage. The operating system is a Linux Ubuntu Server 14.04.

The portal (Fig. 2 shows the structure) is essentially a CMS (Content Management System) based on the Entando Platform (<http://www.entando.com/>) with the support of dbms PostgreSQL (<http://postgresql.org/>) and PostGis (<http://postgis.net/>) functionalities.

The CMS allows the dynamic management of the data model in terms of: taxonomy, the categories of contents; content types, the content structure; and relations between contents and languages for textual description. At the same time the presentation layer is easily modifiable.

DATA MODEL AND DATA SHARING

The Data Model consists of three types of entity: “Nurnet” the archeological site, “Museum” and “Archeological Finds”. The relations between entities are shown in Figure 3 where

re the attribute of “Mono Text” is a non-translatable text, “LongText” is a translatable text with a maximum of 500 characters, “Monolist” is a list of elements, “Link” is a web link. The attribute “Youtube” in the “Nurnet” entity contains a Youtube video code. Currently no data are collected for the “Museum” and “Archeological Finds” entities. Each “Nurnet” entity has a category. As shown in Figure 4 there are 8 macro categories and 14 sub categories.

The Geoportal is multilingual, so all the textual attributes can be inserted for any chosen language.

In the realization of the Geoportal, special attention has been placed on the mechanisms and instruments for data publishing. Firstly, the Nurnet API was created for data sharing and management. Later the Geoserver (www.geoserver.org), an Open GIS Consortium (OGC) Web Service Compliant application, has been added. Obviously all the available data have metadata that describe their genealogy and properties. An example of the use of Geoportal data in mobile device is the “Nurnet Map” App developed for the Android environment. The App can be found in Google Play Store (<https://play.google.com/store/apps/details?id=cordand.nurmap>).

RESULTS AND SUSTAINABILITY

One year since beginning activities Nurnet Geoportal has 96 editors of content and 15 validators. The number of daily unique users of the data is around 50, with peaks of 200 and more in periods near to festivals. The total number of catalogued archaeological sites is 7800, of which 2032, approximately 25%, have been edited and validated.

The archaeological sites and structures, categorized by type, are shown in Tab. 1 and Tab.2. They show the editing activity, using PGIS, from May 2014 to July 2015. In particular, Tab.1 shows the new elements created and Tab.2 those added to the Geodatabase.

Note: in October 2014 only one log-in to modify elements was registered because the server was under maintenance.

Even though it is based on open source software, the system nevertheless has costs, both in terms of financial resources and people with appropriate skills for its management. In order to guarantee the long-term sustainability of the project it is necessary to consider some forms of support. The main cost is the maintenance of the portal that requires certain competencies.

At the moment, the sustainability of the Geoportal Nurnet is guaranteed by voluntary work and research activity but it is clear that a web solution with a discreet favour (successful application of web services) also has some intrinsic potentials if it is possible to apply analytic tools similar to Google analytics. It is clear that the users’ data request to data indicates an interest to a specific archaeological site

of Nuragic and pre-Nuragic period. Furthermore, a user data request can have his geolocation.

The analysis of the user data requests can contribute to the development and selection of indicators regarding the attractiveness of the sites, other than only the site-accessibility indicator; and this can help identify their potentials as economically-valuable touristic resources.

This approach to evaluating the attractiveness of the archaeological sites is essentially empirical, therefore CRS4 and the Nurnet Foundation are working to implement a statistical model based on structured data related to tourist access and available tourist services.

FUTURE DEVELOPMENTS AND CONCLUSIONS

Main objective of the Geoportal is the promotion of the cultural heritage landscape in Sardinia.

Future works may include providing more than one language for the textual descriptions and the implementation of a statistical tool, a sort of decision support system, to help the managers of archaeological sites to diagnose the attractiveness of a site, the changes over time, and comparisons with managed and unmanaged sites. Finally the API of the geoportal will be extended to better manage the feedback from users.

There are many social webs that permit to create and share GIS data (e.g. Wikimapia, OpenStreetMap, Google, etc.). The main idea of Nurnet Geoportal is to create a more accurate and reliable database with a better taxonomy and descriptions of the sites, which will be built on the inputs of the population living in the territory.

The results obtained highlight that the participatory process is a bottom-up approach: it is linked to a local territory and to an issue realized through the direct involvement of local NGOs in the data management and they will be the organizations who will use the data in order to manage a sustainable tourism in the sites interesting from an archaeological point of view. It is also very important to detect where the tourist attractions are not easily accessible to people (Demontis et al. 2013). This approach gives positive results in terms of quantity and quality of the data, and in terms of involving the local population in the production of the data, and thus helping to empower them.

The methodology employed is flexible and replicable for other territories and for other topics.

Finally the Geoportal can be managed in a cloud environment at a relatively low cost. Its success in terms of user access can generate a lot of useful information for the analysis of tourism flows and for regional spatial economic management.

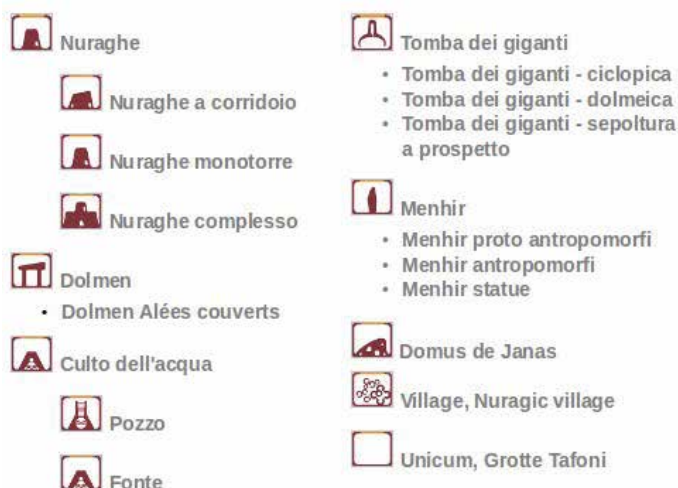


Fig. 4 - Nurnet archaeological features type as listed in the Geoportal legend.

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ABSTRACT

CRS4 (CENTER FOR ADVANCED STUDIES, RESEARCH AND DEVELOPMENT IN SARDINIA) DEVELOPED THE GEOPORTAL NURNET ([HTTP://NURNET.CRS4.IT/NURNETGEO/](http://nurnet.crs4.it/nurnetgeo/)) TO MANAGE AND SHARE INFORMATION ABOUT THE BRONZE AGE IN SARDINIA (ITALY).

THE SCOPE OF THIS PAPER IS TO EXPLAIN HOW THE GEOPORTAL NURNET (NET OF NURAGHES, THE TYPICAL SARDINIAN BUILDING FROM THE BRONZE AGE) HAS BEEN DEVELOPED TO PROMOTE THE BRONZE AGE CULTURE IN SARDINIA, IDENTIFIED IN THE PRE-NURAGIC (3200-2700 BC) AND NURAGIC (UP TO THE 2ND CENTURY AD) CIVILIZATION. IT IS FED BY A NET OF CONVENTIONAL SOCIAL CONNECTIONS AND SOCIAL WEB NETWORKS EMPOWERED BY PRIVATE CITIZENS, AGENTS AND PUBLIC ADMINISTRATIONS SHARING THE SAME GOALS AND INTERESTS.

KEYWORDS

CULTURAL HERITAGE LANDSCAPE; PUBLIC PARTICIPATORY GIS; GEOPORTAL; SARDINIA; ARCHAEOLOGY

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