A collaborative, ontological and information visualization model approach in a centralized rock art heritage platform

Robert A. Haubt, M.A., B.A. Hons. *, Paul S.C. Taçon, Ph.D.

PERAHU, School of Humanities, Languages and Social Science, Gold Coast campus, Griffith University, Queensland 4222, Australia

ABSTRACT

The Rock-Art Database is a rock art heritage project based in the Place, Evolution and Rock Art Heritage Unit (PERAHU), School of Humanities, Languages and Social Science, Griffith University, Queensland, Australia that began in 2012. The project aims to bring members of the global rock art community together in one centralized online platform to share and discuss rock art information in order to make rock art data more accessible and more visible. The platform offers a tool to a wide range of users to collect, manage and disseminate rock art data through specialized functionalities in digital formats that explore new ways to look at rock art through a collaborative, ontological and information visualization approach. The Rock-Art Database was first released in 2014 and can be accessed on the Web at http://www.rockartdatabase.com. This paper presents results of the deployed Rock-Art Database model and discusses its potential for future rock art data explorations.

© 2016 Elsevier Ltd. All rights reserved.

1. The global rock-art database project

The Rock-Art Database is a non-for profit rock art project in the Place, Evolution and Rock Art Heritage Unit (PERAHU), Griffith University in Queensland, Australia. It seeks to improve theory and practice in the digital curation of rock art data through building a centralized global rock art heritage hub. Through the use of new technologies the database explores new ways to look at rock art information and explores the potential within its digital curation.

This paper looks at what motivated the Rock-Art Database project and presents results of a framework that encourages a collaborative, ontological and semantic information structure that uses an information visualization approach, with Australian rock art as a test model within a centralized global rock art platform.

1.1. Project background

Rock art is found across the world at hundreds of thousands of locations and in almost every country. In Australia there are over 100,000 rock art sites, with hundreds of new discoveries made each year. These are important heritage places for Indigenous and non-Indigenous peoples and were made from at least 30,000 years ago to late last century. Many of these sites have not been documented or recorded and are continuously threatened by natural and cultural forces (Agnew et al.,

2015). It is becoming increasingly important to develop conservation plans and management strategies for the protection and preservation of rock art sites, something Griffith University's Place, Evolution and Rock Art Heritage Unit (PERAHU) has actively engaged in since 2011. PERAHU has also been involved with numerous media and online forums to promote awareness of the importance of and threats to Australian rock art. The Rock-Art Database is one of the tools developed for this purpose.

While thousands of rock art records exist on the Web, information on conservation and preservation of sites is often difficult to find hidden away within a highly decentralized system of national, public and private archives. Currently no centralized Australian or global database system exists to curate, present and promote rock art in a single online location. The Rock-Art Database aims to provide such a system to assist with making rock art data more accessible and more visible on a global scale by bringing rock art projects together in one centralized platform.

1.2. Past efforts to centralize rock art data

The idea of centralizing heritage data is not new. Worldwide collaborative networks exist that aim to bring together heritage data from a variety of projects each with their respective aims and objectives. International cutting edge projects include UNESCO's World Heritage List, Google's - Maps, - Earth and - Cultural Institute and the recent European a project, which aims to bring together European heritage data, to name just a few. While all these projects focus on different forms of data centralization, data management or data presentation, rock art related

* Corresponding author.
 E-mail address: robert.haubt@griffithuni.edu.au (R.A. Haubt).

information is scarce and the little information that does exist is often difficult to find. Rock art is often invisible and a system that focuses on identifying and highlighting rock art related information is still missing (Whitley, 2011, pp. 11–15).

In 1997, the journal *Rock Art Research* published an article addressing these issues by proposing the development of an international rock art database (Walt et al., 1997). The article outlined the basic concept of what such a system could look like but no publicly available system was ever deployed and the state of the project remains unclear.

More than a decade later, in 2010, experts again picked up on the idea and proposed the development of a UNESCO *World Rock Art Archive* (UNESCO World Heritage Centre, 2010). The aim was to establish a digital archive to conserve sites on a global scale. But yet again no such system was implemented.

Rock art researchers around the world have been asking for centralized systems for the last few decades. While a number of systems such as the Trust for African Rock Art (TARA, 2015) and its recently established British Museum African Rock Art Image Project (The British Museum, 2015) or the South African Rock Art Digital Archive (SARADA, 2015) have been developed for individual rock art regions and needs, a system that encompasses international sites making global rock art more accessible and more visible, is still missing. Imagine if we could bring all our efforts for creating these thousands of archives together and instead work collaboratively on establishing one central system.

2. Materials

2.1. Collaborative approach

Collaborative approaches are widely used in online platforms such as Wikipedia and can be implemented to not only help with global data collection but also to assist with the technical development of a platform through users adding, editing and filtering data or contributing to open source development from wherever and whenever (Swartz, 2006).

Many heritage organizations started exploring the use of public contributions to expand their data collections through users contributing files in rich-media formats. Such contributions can be found in Europeana (Gavrilis et al., 2015), Europe's biggest heritage database, or projects such as one run by the Power House Museum in Sydney (Bak, 2012). Other heritage projects investigate the potential of public contributions to the reconstruction of artifacts (Stuedahl and Smordal, 2012) or to develop better understanding of visitor experiences in museums (Weilenmann et al., 2013).

Heritage information collection is not the only way to use collaborative approaches. For instance, Murkurtu (Christen, 2013) uses crowdsourcing to assist with software development for heritage projects by making technical data public and allowing scholars and enthusiasts to contribute to the development process.

Similar approaches to the above have been summarized and described by Cunningham and Leuf (2001) within human-based computation whereby data collection, adding new information, editing, filtering and maintaining information is done with the assistance of thousands of contributors and users within online platforms.

Little research has been done within collaborative and human-based computation approaches in rock art (Haubt, 2016). The Rock-Art Database explores such an approach and examines its usefulness within the planning, collection, management and dissemination of rock art information to assist with improving global rock art accessibility and visibility.

But considering the vast amount of information that we would collect, we need to develop a more structured approach to allow for categorizing data to make sense of it all. Tim Berners-Lee (2009), the inventor of the World Wide Web, describes such an approach in the idea of the Semantic Web.

2.2. Information structure

Looking at the amount of rock art and heritage data on the Web we can find a lack of common data structures within planning for data, data collection, management and dissemination. This problem of having a common structure or standard often results in data incompatibility, as well as misunderstanding through, for example, naming conventions or relational misinterpretations of data.

To address this issue online communities are working on developing conceptual models such as (a) common thesauri or (b) an encyclopedia to define naming conventions and to find a (c) common ontology to better understand entities and their relationships within information systems but also (d) metadata formats, to improve our understanding and management of data within information systems.

The heritage community is currently looking at this problem through the CIDOC CRM that provides an ontology and reference model to improve interdisciplinary heritage information structures (ICOM/CIDOC Document Standards Group, 2015). The CIDOC CRM has not been fully utilized by the global heritage community and is still largely unknown within Australian heritage and rock art communities. But a few international projects such as Europeana or the Digital Library (European Commission Information Society and Media, 2011) have started and designed interdisciplinary and collaborative frameworks testing the CRM.

In Australia, the problem of information structure has also been raised within the latest State of the Environment reports, which flag the need to develop better tools for collecting and managing information in order to develop a better understanding of Cultural Heritage and in particular Indigenous Cultural Heritage (Department of the Environment, 2011). Currently no common national or state based heritage thesaurus, encyclopedia, ontology, or metadata approach exists within national archives.

Within the specialized field of rock art a similar picture emerges where very little work has been done to standardize common information structures using an international and interdisciplinary approach (Hannus et al., 2010; Haubt, 2015).

A need has emerged to improve our understanding of information structures by bringing together data from a range of existing international and interdisciplinary projects within a semantic approach using a common thesaurus, encyclopedia, metadata and ontology. Using a common thesaurus, encyclopedia and ontology can assist with improving our understanding of particular entities and entity relations within an international and interdisciplinary system and could help, as suggested by Berners-Lee (2009), to make more sense of complex data.

But while a semantic approach using a common language and ontology can help us make more sense of data, how can we make this complex data more accessible and more visible?

2.3. Information visualization

While visualization of semantic data seems to be largely neglected within heritage applications, Lock (2003) discusses the development from early virtual archaeological reconstructions in the 1960s and 70s to the converging of communication and information technology in more recent years. If we look at visualization in heritage applications we can find a wide range of applications from traditional analogue notebook entries and sketches to the use of virtual archaeology and cyber archaeology (Forte, 2010; Forte and Alberto, 1997). Lock argues that even though new tools are constantly being developed, the understanding of their usefulness for heritage data is questionable and needs further exploration (Lock, 2003; Bleisch, 2012; Huggins, 2005; Koller et al., 2009).

Looking at visualization in rock art a similar picture emerges. While analogue notebooks and sketches are still being used, there is a definite trend towards incorporating new technologies. Many surveys and rock art recordings are still conducted in a paper based way and kept within simple Excel spreadsheets or Access databases but new technologies are