VIRTUAL HERITAGE ARCHIVES:
BUILDING A CENTRALIZED AUSTRALIAN ROCK ART ARCHIVE

R. A. Haubt

PERAHU (Place, Evolution and Rock Art Heritage Unit), School of Humanities, Griffith University, Southport, QLD, Australia – robert.haubt@griffithuni.edu.au

ABSTRACT:

This paper examines use of multi-media in the curation, presentation and promotion of rock art. It discusses the construction of a centralised Australian rock art database and explores new technologies available for looking at rock art.
In 2011, Prof. Taçon Chair in Rock Art Research and Director of PERAHU (Place, Evolution and Rock Art Heritage Unit) called for a national rock art database raising awareness of the importance of preserving rock art as part of Australia's valuable Indigenous heritage (Taçon, 2011). Australia has over 100,000 rock art sites, important heritage places for Indigenous and non-Indigenous Australians and a testament to over 10,000 years of human activity, including interactions with other peoples and the environment. Many of these sites have not been documented or recorded and are threatened by natural and cultural agents. It is becoming increasingly important to develop conservation models for the protection and preservation of sites. Indigenous cultural heritage is difficult to manage on a local government level due to complex human / time / environment relationships and the importance of intangible cultural heritage (SoE SEWPAC, 2011). Currently no centralised database system exists in Australia to curate, present and promote rock art.

1. INTRODUCTION

Technological developments have changed the way we see the world, with organisations striving towards integrated, digital systems for documenting and preserving cultural heritage. As envisioned by Al Gore's 'Digital Earth' such a process could provide improving a collective understanding of peoples place within their natural and cultural environment (Gore, 1998).

This paper reviews use of multimedia by international and national forums for promoting cultural heritage, specifically rock art and assesses the success and / or failures of relevant projects. It investigates how human, time and environment (spatial) issues have been addressed through the use of new technologies; examining user content representations, user content collections and applied technologies. The paper further examines the relevance of information systems to Indigenous communities, investigates involvement of Indigenous and non-Indigenous parties, how information is collected, what kind of information is collected and how this data is then stored and presented for the assigned purpose within individual heritage applications. The paper assists with the identification of knowledge gaps within Australian rock art management.

2. CULTURAL HERITAGE

2.1 International

Organisations, Databases and Management A collaborative network of world heritage organisations exists, providing management and technical support for cultural and natural heritage projects. While most organisations focus on their own particular field, the United Nations aims to create centralised knowledge networks.

UNESCO's 'World Heritage List' currently includes 962 sites with most sites managed by local, self-regulating authorities who report back to UNESCO (IUCN & UNEP-WCMC, 2012; UNESCO, 2008; UNESCO, 1972). Organisations such as Google, CyArk and the Global Heritage Fund assist by offering

state of the art technological solutions for documentation, management and monitoring of sites. While each organisation focuses on its own specialised field, information is shared within a greater online network and made publicly available.

Google, for example, offers geolocation tools 'Google Maps' and 'Google Earth' to organisations around the world but also runs its own projects within cultural heritage. The 'Google Art Project' uses the latest in spherical imaging technologies to visualise exhibitions from museum, art galleries and rock art to the public, using virtual and interactive formats.

CyArk's mission on the other hand, is to capture heritage sites in high quality three dimensional reconstructions. While the project features its own browser integrated 3D viewer application for high definition point cloud displays, 3D models are also shared with Google and UNESCO's heritage projects.

The Global Heritage Fund started its new project the 'Global Heritage Network' (GHN) in 2010. The project aims to provide a comprehensive conservation monitoring tool for heritage sites around the world. While the project features its own web portal, integrated heritage site information is obtained from other heritage projects around the world. GHN's centralised platform makes this information accessible through a virtual online experience bringing together different media formats such as text documents, satellite imagery, 3D models and GIS data in its own platform.

While not all 'World Heritage' sites are part of these projects, Google currently lists 184 galleries and museums, CyArk lists 33 high definition 3D reconstructions and GHN monitors over 650 heritage sites. With expanding networks and a collaborative approach UNESCO, Google, CyArk and GHN are one step closer towards a 'Digital Earth' (UNESCO World heritage List, 2012: Partners). But while these big organisations lead the way, the process of such collaborations between cultural heritage departments and information and communication industries is of current interest in many other archaeological, anthropological, historical and museum studies (eg Forte, 2010;

Cameron et al, 2007). As collaborations between heritage organisations and the computer, information and communication industries expand, issues arise in the curation, presentation and promotion of cultural heritage. Methods are required to bring together cross-disciplinary information across multiple media formats, spatial and time scales. While specialisation allows organisations to excel within their particular field of expertise, oversight is needed to integrate this information within a centralised platform. Currently no single centralised system exists that provides access and manages all aspects of heritage on a global scale (UNESCO, 1972; UNESCO, 2008; IUCN & UNEP-WCMC, 2012: see partner projects). This paper considers the feasibility of a centralised repository for cultural heritage information that will allow interdisciplinary collaboration and information sharing on local, national and international levels.

Representation of Content, User Content Classifications and Applied Technologies UNESCO recently announced its own new Geolocation Content Management System (GeoCMS) 'Cultural Heritage Resource Information System' (CHRIS)[*]. CHRIS was developed to provide a tool that allows for the collection of information necessary for World Heritage Nomination. Based on the world heritage guidelines CHRIS is currently implemented in the 'Silk Road Project' gathering data from different participating Central-Asian countries in different media formats including textual documentation, photography, photogrammetric and remote sensing data. Engaging local communities from different countries the project currently faces problems within the use of multiple languages, secret and sacred data exchange and computer literacy. Some of these issues are addressed through access level restrictions and making data more accessible to the general public through visualisation. But as the project grows new challenges arise (Vileikis, 2012).

Google and Cyark have a predominantly visual approach. Google Street View and the Google Art Project allow visitors to immerse themselves in virtual spherical and panoramic tours based on high definition photographs. This spherical and panoramic approach is also implemented in a range of heritage projects. The use of such panoramic technologies is the subject of ongoing discussion within heritage communities (eg Koehl, 2012). While Google is taking a two dimensional panoramic approach CyArk is taking a three dimensional approach to visual representation. Originating from the remote sensing industry CyArk currently offers five different ways to explore heritage sites - in text, photographs, 3D point cloud models, maps and virtual tours. Research into the use of three dimensional models in cultural heritage is ongoing and has been summarized by Forte, Lock and Cameron (Forte, 1997; Forte, 2012; Lock, 1987; Lock 2003; Cameron et al, 2007). While some projects focus on the accuracy of three dimensional models others raise concerns questioning the usefulness of such digital reconstructions in cultural heritage (eg Bleisch, 2012; Huggins, 2012; Koziol, 2012; Nakata, 2012; Sylaiou, 2012).

GHN is taking a different approach by focusing on conservation monitoring using the latest in photogrammetric, remote sensing and Geographic Information System (GIS) technologies. GHN combines textual, 2D image, satellite image, photogrammetric, 3D model and GIS data using the Google Earth interface. The intuitive design allows for easy data access through visual as well as textual search functions. But while GHN offers these state of the art technologies, research into the usefulness of

remote sensing applications in cultural heritage continues (eg Bleisch, 2012; Koehl, 2012).

Summary A sophisticated network of cultural heritage organisations and publically accessible applications has been launched by UNESCO and related heritage organisations. Working together, each organisation excels within and focuses on particular fields of interest applying the latest state of the art technologies. While technologies develop fast, questions have been raised about the appropriateness and purpose of new technologies within cultural heritage applications and a need for further research has been identified.

2.2 National Government

Organisations, Databases and Management While UNESCO is managing World Heritage sites through an international network of partners, little evidence of such organised networks can be found in Australia. The Australian heritage system is highly decentralised officially listing 36 government and 13 non-government organisations (SEWPAC, 2011). Each state is running its own heritage system complying with its own state regulations under the umbrella of the Australian Government 'Department of Sustainability, Environment, Water, Population and Communities' (SEWPAC). Without standardised naming conventions for national and state departments and new organisations emerging that have not previously been listed on the SEWPAC, it is difficult to evaluate Australian heritage organisations on a national level. The SEWPAC reports revealed a lack of structure, management, protection, collaboration and detailed information on Indigenous Heritage in particular (2011).

The national heritage body SEWPAC as well as each state frequently assess overall performance of heritage management through the 'State of the Environment' (SoE) reports. While the reports must comply with a set of national standards each state provides its own Key Performance Indicators (KPIs) within the SoE. This makes direct comparison and evaluation on a national level difficult as each SoE focuses on different KPIs within heritage management (eg SoE SA focuses on compliance; SoE ACT focuses on reporting mechanisms; SoE SEWPAC focuses on appropriateness of documentation tools for Indigenous Heritage). The last SEWPAC SoE report evaluated five areas within heritage management: 1. Identifying Indigenous heritage 2. Managing Indigenous heritage 3. Protecting Indigenous heritage 4. Leadership in Indigenous heritage 5. Celebration of Indigenous heritage. Poor performance was identified within areas 1 – 4 and some sections of the report were left blank due to a lack of information. The low performance was largely contributed to a lack of understanding Indigenous heritage and inadequate tools and resources. Currently, little is done to improve this situation (SoE SEWPAC, 2011).

Similar results are found within state based SoE reports. No state report contains comprehensive information on identifying, managing and protecting Indigenous heritage but all reports identify inadequate knowledge of indigenous people, Indigenous culture and peoples relations with environment (SoE ACT, 2011; SoE NSW, 2012; SoE NT, 2009; SoE NT, 2013; SoE QLD, 2011; SoE SA, 2008; SoE TAS, 2009; SoE VIC, 2013; SoE WA, 2007). While the SoE from South Australia states that most Indigenous heritage sites and knowledge is currently discovered through research related to mining projects (SoE SA, 2008) the ACT and Tasmania reports question the appropriateness of applied tools to reporting and monitoring the condition of heritage sites (SoE ACT, 2011; SoE TAS, 2009).

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[*] UNESCO: CHRIS: http://www.silkroad-infosystem.org/

A huge gap has been identified identifying, managing and protecting Indigenous heritage management. The SoE reports revealed that little to no information exists within a highly decentralized system, questioning the appropriateness of applied tools on a state and national level.

Representation of Content, User Content Classifications and Applied Technologies The SoE reports reveal little information on representation of data, collected data and applied technologies. Taking a closer look at the national archive, the SEWPAC archive appears comprehensive while the ACT's and Tasmania's archives seem to be managed in basic downloadable excel spreadsheets.

SEWPAC provides a comprehensive archive with over 22,300 entries listing World Heritage as well as National Heritage listed sites. SEWPAC's heritage database interface offers the user two search options using statistical and key word search as well as a visual interface using Google Maps. All state registers provide similar search functions but with generally less features than SEWPAC's. Running a basic key word search on 'Indigenous Heritage', 'Aboriginal Heritage' and 'rock art' reveals shocking results. While SEWPAC still provides 1097 results for Indigenous Heritage and 44 for rock art most other databases do not allow for specific Indigenous Heritage searches and/ or hardly list any sites. The state registers are clearly designed for Eurocentric heritage management with heritage forms focusing on architectural features and design. Furthermore, no standardized format can be found across state and national registers as each state uses different heritage register forms. Looking at more details within the forms all registers provide basic textual data, photographs and geolocation data (ranging from address to geo coordinates). Little use of multimedia is evident and photographs are simply attached to the records without any further descriptions of the attached images. A need for further investigation into Indigenous archives and the use of new technologies has been addressed not only by the SoE reports but also the Aboriginal Land Council (ALC, 2010) and within AIATSIS (Davis, 2012).

Summary A need for adequate databases and exploration of new technologies has been identified through state and independent reports within Australian government archives.

2.3 National Non-Government

Organisations, Databases and Management Due to the highly decentralised Australian heritage system it is difficult to assess the state of non-government heritage organisations and their role in cultural heritage. While many government organisations collaborate with universities, research, community and private organisations no comprehensive list of current projects exists within government archives (SoE ACT, 2011; SoE NSW, 2012; SoE NT, 2009; SoE NT, 2013; SoE QLD, 2011; SoE SA, 2008; SoE TAS, 2009; SoE VIC, 2013; SoE WA, 2007). SEWPAC currently only lists 13 non-government organisations but looking into the individual SoE reports, this list grows fast.

To address this issue of decentralisation within Australian archaeology a campaign was recently launched to centralise archaeological information across the country. The Federated Archaeological Information Management System (FAIMS) aims to centralise archaeological information in collaboration with university, research and community partners but so far no outcome has been reported.

Many projects and collaborations exist within Australian universities, private heritage organisations and Indigenous communities aiming to find new ways to manage Indigenous heritage information in Australia. Organisations such as Environmental Systems Solutions and Mukurtu specialize in building comprehensive archives for archaeological and cultural data collection through consultation with researchers and Indigenous communities. Little research has been conducted and there is a need for further investigation of existing studies (Mukurtu, 2012; Gibson, 2009; Christen et al, 2012; Christen et al, 2008; Christen, 2007; Bidwell, 2007).

Other projects like Sahul Time and Virtual Warrane II (formerly the Digital Songlines Project) specialize in the use of spatial and temporal data through visualisation in geolocation systems and game engines. While Sahul Time focuses on representation of scientific archaeological studies (Coller, 2009), Virtual Warrane II explores the use of its system within Indigenous heritage and knowledge management (Bradley et al, 2008; Gibbons et al, 2006; Leavy et al, 2007; Leavy, 2007; Nakata, 2012; Pumpa et al, 2006). Similar to ESS and Murkurtu little research has been conducted and there is a need for further investigation. The decentralisation of heritage systems leaves a big gap within national heritage management with limited exchange of heritage information and projects. While information is shared within smaller collaborative networks and conferences no central system exists and only little research has been conducted within selected projects.

Representation of Content, User Content Classifications and Applied Technologies Comparing ESS databases, Mukurtu, Sahul Time and Virtual Warrane II a vast range of state of the art technologies can be identified within the systems. Technologies range from basic textual to GIS, remote sensing and virtual displays.

ESS and Mukurtu currently run multiple projects across Australia but focus on different technologies. While ESS specializes in GIS, Mukurtu aims to build a freely available Open Source (Drupal) cultural heritage platform developed through online user communities across the world. Sahul Time and Virtual Warrane II both explore spatial reconstructions of landscapes over time. But while Sahul Time has a clear archaeological focus, Virtual Warrane II aims to develop a toolkit for Indigenous knowledge through exploring the potential of game engines in an Indigenous Heritage context (Bradley et al, 2008; Gibbons et al, 2006; Leavy et al, 2007; Leavy, 2007; Nakata, 2012; Pumpa et al, 2006). All four projects utilize the latest in multimedia, remote sensing and GIS technologies. Once again little research has been conducted and there is a need for further investigation into technologies within a cultural heritage context.

Summary Looking at a selection of current Australian heritage applications a big difference can be found within the use of technologies in international, government and non-government systems. International heritage organisations work in global collaborative networks exploring the use of new technologies but Australian government and non-government organisation lack such a centralised approach. While GIS, remote sensing and game engine technologies have been applied within individual non-government projects, government archives make little use of such new technologies. A need for further exploration of new technologies within Australian heritage management systems has been identified.

3. ROCK ART

3.1 International

Organisations, Databases and Management While international heritage organisations like UNESCO are working on collaborative networks bringing together heritage and information and communication industries from around the world, little has been done within the management of rock art.

The UNESCO World Heritage List contains several rock art sites but in recent news UNESCO announced the creation of a separate dedicated 'World Rock Art Archive'[*].This exiting development has brought experts from around the world together and three meetings have already taken place between 2010 and 2012, but so far no outcome has been published.

Further efforts have been undertaken by the International Federation of World Rock Art Organisations (IFRAO) and the Australian Rock Art Research Association (AURA) starting international discourse through organising global rock art conferences. But while these conferences and associated website contribute to sharing of information within individual case studies no global archive has been established.

In 2011 a 'Global Rock Art Website List' was compiled at Griffith University (Taçon & McNeil, 2011) to evaluate the state of international rock art online representations. The evaluation revealed that most websites and online portals focus on their own specific projects collaborating in smaller networks within sharing data within greater networks. Websites such as the Bradshaw Foundation and Preistorica provide comprehensive lists of projects but no management tools such as seen in CHRIS, CyArk or GHN. Comprehensive rock art research paper archives are also found within Universities such as UC Berkley or the University of Arizona but again fail to provide more than just a platform for research papers.

Within the scope of this research no central international database and only limited collaborative networks have been identified within international rock art management. While some platforms provide comprehensive lists of rock art research most databases focus on individual project agendas, only.

Representation of Content, User Content Classifications and Applied Technologies While most rock art websites use basic html designs displaying textual information and photographs it is difficult to assess the exact content of all projects. Most websites provide links and references to pdf and word versions of research papers containing more detailed information about applied methods and technologies. But this information is mostly not available within the front end of the website.

Using Taçon's and McNeil's method of website evaluation three main website categories have been identified: 1. Basic Website using text, 2D images, photographs, references, lists 2. Intermediate Website using text, 2D images, photographs, references, lists, maps, panoramic images 3. Advanced Website using various forms of multimedia, 3D models, virtual tours or animation. Category 1 websites are often simple in design but contain valuable references to research papers and photographs (eg Casties et al, 2006). Category 2 websites are often designed for general interest or tourism using virtual tours to immerse the visitor into the landscape. None of these websites however explore the use of panoramic images for research purposes.

Within category 3 only one single website stood out using the latest in multimedia technologies to display rock art in an immersive and educational way. The Lascaux Cave website uses animated three dimensional virtual tours to immerse the visitor and researcher into guided or self guided tours.

But while new technologies such as virtual tours, 3D models, photogrammetry and laser scanning are already widely used within cultural heritage documentation, little research has been undertaken exploring the use of new technologies within rock art. While rock art researchers still greatly rely on text descriptions, sketches, drawings and photographs (Fryer et al, 2005; Chandler et al, 2005) and detailed three dimensional recording techniques improve a need for further research into two and three dimensional rock art documentation has been advocated (Hanke, 2000; Rivett, 1980; Domingo et al, 2013).

Summary A gap has been identified within the use of new technologies within rock art research and management. While new visualisation technologies in photography, photogrammetry, laser scanning and other remote sensing technologies have been widely applied within other heritage applications little research has been conducted within rock art.

3.2 National Government

Organisations, Databases and Management Very little information on rock art can be found within the national and state heritage registers. SEWPAC provides some basic information about areas that contain rock art such as Kakadu National Park but do not provide any further information on rock art, other than its existence within the park.

Representation of Content, User Content Classifications and Applied Technologies As mentioned in the 'Cultural Heritage' section, the heritage registers are difficult to use and provide little tools that allow the evaluation of Indigenous heritage or rock art management. SEWPAC provides little information on rock art within national parks but included images are not labelled or referenced. As the search functions are limited it is difficult to find any further information on rock art.

Summary A gap has been identified within government archives, managing and protecting rock art sites. Little information exists on location and condition of sites and no new technologies (such as seen on an international cultural heritage level) have been implemented.

3.3 National Non-Government

Organisations, Databases and Management Within Australia's decentralised heritage system various types of rock art organisations and projects can be found from research to tourism. While some work on spreading awareness of rock art related issues, the majority of projects are run individually often with limited resources and limited collaborative work. It is difficult to assess how many rock art archives and projects currently exist due to a lack of records within national and state archives.

AURA and the Place, Evolution and Rock Art Heritage Unit (PERAHU) are working on spreading awareness of rock art related issues and promote networking across Australia. But their websites currently do not provide comprehensive lists of Australian rock art sites and projects. Organisations such as the Bradshaw Foundation and the Kimberley Foundation offer a more comprehensive and accessible list of sites but focus

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[*] UNESCO: Rock Art Archive http://whc.unesco.org/en/rocktart/

mainly on their own individual projects. Since 2009, three rock art research centres have been established within Australian Universities: 1. The Rock Art Research Centre at the Australian National University 2. The Centre for Rock Art Research and Management at the University of Western Australia and 3. PERAHU at Griffith University. All three centres engage in national rock art research but little information is shared within the University portals as most information lies within separate project databases often maintained and run by researchers and / or Indigenous communities.

One such database is developed and maintained by the Mirarr people, the ANU, PERAHU and Environmental Systems Solutions Pty Ltd[*]. The database is designed for research, planning, surveying, managing and conservation monitoring of rock art using three forms for data recording: 1. Basic Site Recording Form (used by Kakadu National Park) 2. Site Detail Recording Form (used by local community and researchers) 3. Motif Recording Form (high detail recording form used by community and researchers). While ESS currently offers one of the most advanced heritage recording systems in Australia (Bidwell, 2009; Gibson, 2009) little research has been done on the use of databases and new technologies within rock art management.

No centralised rock art database currently exists in Australia complicating rock art management and exchange of rock art information. Contextualizing the issue within national and state Indigenous heritage management no system exists to manage elements of Indigenous heritage such as rock art.

Representation of Content, User Content Classifications and Applied Technologies While no comprehensive studies have been conducted evaluating the representation and use of new technologies in Australian rock art, the need for further investigation has been addressed by rock art researchers around the country.

Looking into ESS's database the Mirarr Rock Art project is currently setting new trends using the latest in GIS, photography, panoramic photography and communication technologies but because it began in 2012 no outcomes have been published to date. Other previous research mainly focused on textual and 2D documentation of rock art while photogrammetry, laser scanning and other virtual forms of representation have been greatly neglected (Rivett, 1980; Chandler et al, 2005; Fryer et al, 2005).

Summary A gap has been identified within the use of new technologies in rock art recording. With ESS introducing GIS technology in rock art research as recently as 2012 and Fryer and Chandler addressing the need to explore point cloud systems and photogrammetry a need for further exploration into the use of new technologies has been identified.

4. CONCLUSION

Based on the findings discussed in 'Cultural Heritage' and 'Rock Art', this paper proposes the development of a much-needed national Australian rock art database system using new technologies to explore, curate, present and promote rock art. Combining the latest state of the art database management tools and visualisation technologies the system will provide a new perspective on rock art but also comply with existing standards.

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[*] Mirarr Rock Art Project: http://www.mirarrrockart.net/

Organisations, Databases and Management: The new database system will address gaps within local, state and national rock art management through the use of visual technologies placed within a greater Indigenous heritage management context. This will allow to bring together rock art and relevant cultural heritage projects and organisations from across Australia in a centralised national system. The new database system will allow us to look at and to compare rock art from a macro level (including basic location and site descriptions) to a micro level (including detailed motif descriptions). The database system will further provide a new collaborative platform bringing together heritage researchers and Indigenous communities complying with existing systems. The system will offer a platform for academic research but will also make scientific and cultural research data more accessible to the greater public. Key elements will include tools for planning, identifying, managing and protecting rock art and providing leadership through the use of latest state of the art technologies. Considerations:
• allowing for diversity of communities
• acknowledging Indigenous knowledge protocols and IP
• providing communities control over content
• consulting with communities over design, development, implementation and maintenance
• complying with state and national reporting needs (eg. SoE)
• complying with rock art reporting needs (eg community, research)

Representation of Content, User Content Classifications and Applied Technologies: Using state of the art technologies the database system will provide a repository for information relating to rock art (including related oral histories). Focusing on visualisation and usability the database system aims to be easy to navigate with an intuitive user interface. Appropriate for Indigenous communities and academic researchers alike, the database will be made accessible for outside interaction allowing for integration of mobile communication devices. The implementation of new 2D and 3D media as well as new search functions will fill the gap within national archives allowing searching for textual as well as visual data. The database will include but not be limited to:
• statistical search for relevant reporting and research
• Key word and category search functions
• Search functions for attachments (eg pdf, word documents)
• Visual search functions in 2D / 3D spaces (eg shapes, colours)
• Audio search functions (transcription tools)
• Temporal search functions
• Use of multimedia data (eg 2D, 3D, animation, sound, film)

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