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Proposal for the enhancement of Marzamemi's underwater heritage through the use of digital methodologies

M B Prados-Peña¹, M P Sáez-Pérez² and A García-López³

Abstract. This article discusses the importance of technology in the enhancement of underwater heritage, using the Wreck of the Church in the coastal area of Marzamemi (Italy) as a case study. This heritage site is under study in the framework of the European research and knowledge transfer project, WARMEST. There is an increasing variety of digital tools that promise to improve people's experience with heritage sites, to enhance the value of heritage and contribute to the socio-economic development of the territories. A strategy is proposed for Marzamemi underwater heritage site, where communication efforts give potential visitors a sense of the destination that motivates them to choose it and encourage them to talk widely about their experience. To this end, digital tools are a great asset in establishing such a communication strategy to increase information about this heritage on the various websites and social networks related to Marzamemi, so that knowledge of Marzamemi's underwater heritage would undoubtedly be enhanced.

1. The value of Cultural Heritage

Cultural heritage is an economic asset and a source of wealth and employment (Bowitz y Ibenholt, 2008; Greffe, 2004; Oppio at al 2015; Tuan y Navrud, 2008; Wright y Eppink, 2016); a territorial resource with the inherent potential to become a tourist attraction (Carbone, 2016) y un factor de identidad, que puede contribuir a la cohesión social (Pasikowska-Schnass, 2018). Cultural heritage is an important driving force in the European economy, society and culture (Trillo & Petti, 2016). Therefore, using heritage resources in a sustainable and responsible manner is an excellent opportunity to contribute to improving people's living conditions, both materially (wealth, employment, innovation, entrepreneurship) as well as in the immaterial (identity, participation, training, satisfaction, enjoyment, etc.) (Domínguez-Pérez y Martín-Fernández, 2015). It is evident that there is a growing interest and concern in most places in the design of activities that allow the valorization of their heritage (Greffe, 2004). As a result, in recent years there has been an increase in the number of studies that address the valorization of heritage from different perspectives (Caldwell, 2000, Camarero, Garrido-Samaniego y Vicente, 2012; Liu, Liu y Lin, 2015; Kim, Stepchenkova y Yilmaz, 2019; Sanz y Herrero, 2006; Tuan y Navrud, 2008). In this line, throughout 2018, the European Commission declared the European Year of Cultural Heritage (EYCH). Therefore, all Member States and EU institutions have been organizing events, conferences and meetings, and funds have been allocated to preserve and promote all forms of cultural heritage (Pasikowska-Schnass, 2018). Complementarily, in 2015, the report on "Getting cultural heritage to work for Europe" (EC, 2015b) emphasized that cultural heritage does not imply, as is often claimed, only costs, nor is it limited to aspects related to identity, but that it has multiple positive effects, among which the areas stand out:

¹ Department of Marketing and Market Research. University of Granada, Spain

² Higher Technical School of Building Engineering. Department of Architectural Construction. University of Granada, Spain

³ Faculty of Fine Arts. Department of Drawing. University of Granada, Spain



- Economic: cultural heritage can be a model of economic production that has a positive impact on job creation, even in other sectors
- Social: where cultural heritage promotes integration, inclusion, cohesion and participation, and
- Environmental: where cultural heritage enables the sustainable development of landscapes.

Likewise, the report Cultural Heritage Counts for Europe (CHCfE, 2015) highlights the need for an integrated approach in which the social, cultural, environmental and economic impacts of heritage are fundamentally intertwined; as shown in Figure 1 in which the truly integrated approach to heritage in which benefits can be maximised can be graphically observed. In this document, the beneficial effects of cultural heritage are also listed. Highlighting that:

- increases the attractiveness of the territories and contributes to their development
- contributes to the quality of life of the inhabitants and to improve the atmosphere in the neighbourhoods
- improves the uniqueness of these places and provides narratives for cultural tourism

In Figure 1, the report Cultural Heritage Counts for Europe 2015 highlights the potential of cultural heritage as a key driver of sustainable development in a wide range of policy areas.

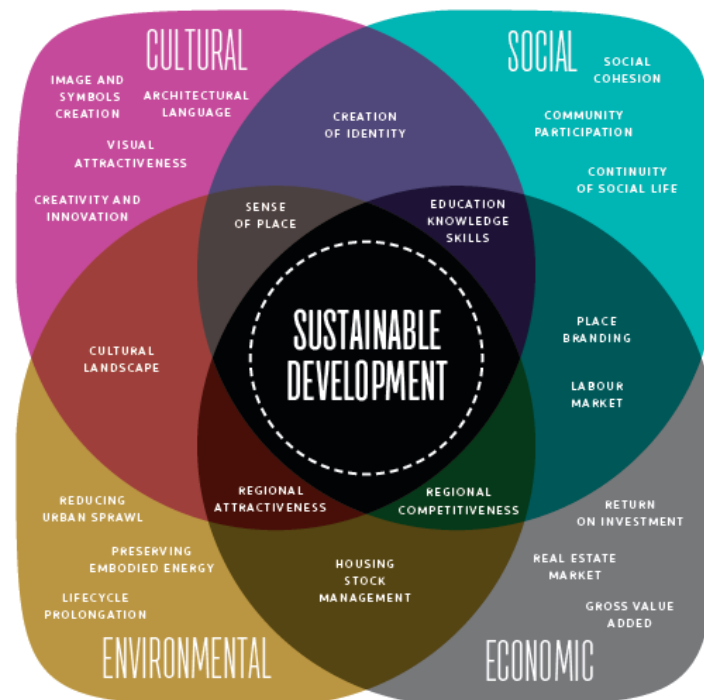


Figure 1. The different subdomains identified in the collected studies mapped in the holistic four domain approach diagram. (Cultural Heritage Counts for Europe CHCfE Consortium 2015)

Finally, it is important to address the role of digital technologies in the value of heritage. According to Van Balen (2017) they facilitate the preservation of cultural heritage, the exchange and joint creation of information for heritage conservation. In this sense, technological development can help to control these factors; however, according to this same author, at first sight it becomes evident that the main advances will have to come from the design of strategies, intelligent integration and the stakeholders involved that bet on the sustainable development of cultural heritage, thus guaranteeing lasting effects on all existing resources.

In relation to these, this study focuses on underwater heritage, a typology that has become accessible thanks to new technologies. This research, based on the need to transform and integrate the value of underwater heritage by incorporating it into the context of society as a tourist value, aims to

identify/propose the search for new operational tools to help initiate the processes of dissemination, as established by UNESCO 2001, Aznar (2018); Nautical Archaeological Society (2009); Maarleveld et al.

In accordance with MACHU project 2008, which states that "Projects shall provide for educational activities and the dissemination to the public of project results, as appropriate", the various research projects have made it clear that the results must be shared with the public. In this case, the research is part of a European WARMEST project (loW Altitude Remote sensing for the Monitoring of the state of Cultural hEritage Sites: building an inTegrated model for maintenance). The objective of WARMEST is to develop a Decision Support System for the management and maintenance of heritage sites. This system, which should lead to the creation of the Cultural Heritage Risk Analysis tool - ARPAC (or Cultural Heritage Risk Analysis - CHRA), aims to become a tool capable of suggesting the best option in the maintenance and management of historical and natural heritage spaces. In addition, it is configured as a system of anticipation and prevention of greater damage in the maintenance and management of heritage. In this way, and in line with the MACHU project 2008, the various actions will make information on underwater cultural heritage accessible for academic, social, tourism and sustainable purposes, which will inevitably generate greater public understanding and the need to protect the sites.

2. Underwater Heritage. The Marzamemi case study

The UNESCO 2001 Convention defines the term "underwater cultural heritage" in its article 1.1.a as: "all traces of human existence having a cultural, historical or archaeological character which have been partially or totally under water, periodically or continuously, for at least 100 years", certainly including the underwater archaeological sites of the Marzamemi area in Sicily (Italy).

2.1 Marzamemi

The coastal town of Marzamemi, located in southeastern Sicily, was founded in the 11th century by the Arabs and over time it became one of the most important towns in Sicily. In its historical context, the 'Wreck of the Church' earned it a place in the first accounts of the maritime history of the ancient Mediterranean, and it has witnessed centuries of maritime connectivity and exchange. Especially in the study of late antique construction, religious architectural decoration and more recently in the knowledge of the logistics and economy of the ancient maritime trade in architectural stone. The ship sank in shallow waters (7-8 m) in the 6th century BC, while carrying a massive cargo of largely prefabricated architectural elements, intended for the construction and decoration of a church somewhere in the old West. Various investigations Leidwanger and Tusa. (2016), Repola et al. (2018), indicate that it was first explored in the 1960s, and has been investigated since 2013 by Stanford University (<https://marzamemi.stanford.edu/>) y la Soprintendenza del Mare

(http://www.regione.sicilia.it/beniculturali/archeologiasottomarina/sez_eventi/marzamemi_2014.htm) giving rise to various publications, as part of the Marzamemi Maritime Heritage Project (Leidwanger et al. 2015, Leidwanger and Greene 2017). With an area of approximately 2,500 m² (<https://marzamemi.stanford.edu/>), its findings include a large number of rare architectural pieces, among which large marble columns, capitals, bases, carved panels and other religious decorative pieces have been confirmed (Leidwanger et al., 2014). All of them are scattered and due to the natural conditions of the site, they can be seen buried or half-buried in the sand and with large rock falls and parts of the reef that affect the objects of the shipwreck. Regarding their conservation, it is recognized that they are very uneven: "some columns, capitals and bases are worn, while other marble elements seem to have suffered minor bites". (Repola et al., 2015).

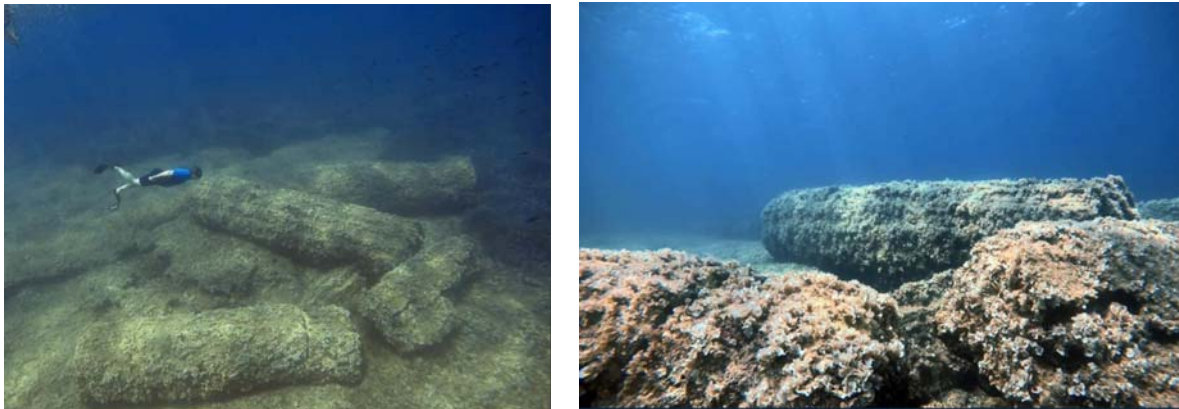


Figure 2. Images of the Wreck of Church underwater heritage site taken by the WARMEST in August 2019. <https://warmestproject.eu/>

With regard to the studies carried out at the archaeological site, those that have focused primarily on the mapping of existing elements, the study and the representation of 3D data of the space that will allow the development of the objectives foreseen in the research, protection and enhancement of the underwater cultural heritage, stand out for their interest. Such is the case of three-dimensional (3D) models derived from digital survey techniques that have increasingly become a pillar of archaeological research and cultural heritage management. The high accuracy of such modelling makes it an attractive solution to a wide range of challenges, all related to the dissemination and enhancement of heritage. (Repola, et al. 2018); (Carlson and Scoward. 2010). Complementarily different experiences and studies like the one by Balleti et al. 2015 show that digital photogrammetry of multiple real images is also a good solution for underwater archaeology. Their texturization and content detail as well as the accuracy of such models make them attractive and useful for a wide range of purposes, both for specialists and the general public. The search for new techniques, processes and methods to enable better consistency and accuracy of underwater digital survey data must be placed within a broader scientific context in which the same data assume many different purposes in a sophisticated, multidisciplinary analytical environment. At the same time, it provides an opportunity to develop innovative management and dissemination of maritime heritage.

3. Digital strategies, an opportunity for heritage enhancement

All these studies according to Cwi and Lydall (1977) identify the need for academic literature to enhance work on heritage appreciation from an interdisciplinary perspective, in order to improve understanding of the composition and drivers of heritage value. In this sense, and from the transversal nature of the management of cultural heritage, deepening knowledge of consumer behaviour with regard to heritage becomes an element to be taken into account by heritage managers (Aaker, 1991; Prados-Peña, Gutierrez-Carrillo and Del Barrio-García, 2019). According to Aaker (1991), the essence of the cultural heritage marketing process is to discover what the client wants and to deliver it, taking into account any restrictions that may prevail, such as the need to protect parts of a cultural heritage site due to increased wear and tear caused by the increase in the number of visitors, stimulated through marketing initiatives. Therefore, the visitor should be satisfied, but not to the detriment of the heritage property that should be preserved for future generations.

In the digital age, the Internet can play a vital role in valuing heritage (Giaccardi, 2012; Gregory, 2015; Lewi et al., 2016). This includes values related to identity and social life in cities, which are generally considered difficult to observe due to their intangible and subjective nature (Sykes and Ludwig, 2015). However, despite Europe's rich cultural heritage and the deployment of a new approach to exhibition and dissemination tools in museums and cultural institutions, the participation of the general public with regard to cultural heritage remains low (Floch, et al. 2014).

Lewi et al. (2016) look at the ways in which visitors connect and interact with heritage through a wide range of digital and social networking applications related to the history of places. With their emphasis on connectivity and online participation, these applications and the sites themselves seek to create both

repositories and digital communities through which images, memories and experiences can be shared. These authors, based on a detailed analysis of citizen participation, what they call the emergence of "citizen science", propose a new way of categorizing these mobile applications and websites. Thus they consider that there are three typologies of sites where citizens share information about heritage sites: curated sites, content-hosting sites, and social network sites. These provide a way to examine the possibilities and limits for a type of digitally enabled 'heritage citizen'. In this context, and in line with these authors, it is worth asking whether the new technologies (websites, social networks, mobile applications, 3D, ...) open up new forms of consumption, interpretation and production of heritage content, which also foster the commitment of citizens to culture and their heritage, in line with (Beltrán et al, 2014).

There is a growing range of digital tools that promise to enhance people's experience with heritage places, including historic tour applications, web-based photo and audio-visual archives, and Facebook groups (Lewi et al., 2016). While many of these tools rely heavily on traditional forms of interpretation, such as signage or guided tour and guidebooking (Lewi & Smith 2011). However, they provide new ways to see places, visit them and exchange information, thoughts, memories and experiences (Lewi et al. 2016). Floch et al. (2014) note that although ICT-based personalization, as a means of enhancing the visitor experience at a cultural site, has been a major research topic over the past twenty years, little attention has been paid to cultural experiences that somehow mark the citizen for life, i.e., the public's engagement with culture beyond the single or multiple site visit. So it has not been taken into account that cultural sites differ, leading to a diversity of needs that must be considered through a personalization approach.

4. A proposal for Marzamemi, based on the positive results of the use of digital methodologies in different heritage milestones

The presence of Marzamemi's underwater heritage on the Internet is low. Specifically in Tripadvisor, one of the most successful platforms related to tourism and travel (Bjorkelund, Burnett and Norvag 2012), there are only 3 comments about the Roman columns, although they have been rated as excellent. In generic internet searches it is also difficult to find specific references to Marzamemi's underwater heritage.

With these premises, the present study aims to show that digital tools can potentially open up new ways of exploring and articulating a community's relations with the physical and social environments, thus enabling a form of social production of heritage as the site of our 'sense of place' (Giaccardi and Palen, 2008). When successful, they can also function both as a way of creating and/or archiving artefacts and stories of intangible heritage located within the tangible structure of buildings, sites and places (Lewi, & Smith, 2016). Despite recognizing the importance of these tools, to date, few studies and analyses have focused on the effectiveness and value of digital applications and social networks applied to the practice and consumption of cultural heritage (Lewi, & Smith, 2016).

Hence the importance of the examples described below, where it is established that communication plays a decisive role in heritage management as do communication strategies based on digital tools that must be part of the management plan for any heritage asset, as is understood to be the case with MARzamemi.

In the first case, Boivin & Tanguay (2019) analyse the factors that determine the attractiveness of a tourist destination, in their case the cities of Quebec (Canada) and Bordeaux (France). These authors conclude that the dissemination of information about the destination on the Internet and on social networks changes the interest of travellers in the tourist destination. Communication efforts should give potential visitors an idea of the destination that motivates them to choose it. Encouraging current tourists to talk extensively about their experience is therefore a promising way to strengthen the attractiveness of cities (Boivin & Tanquay, 2019).

In the second case, Krakover (2012) in his study on Jewish heritage tourism in the peripheral cities of Serra da Estrela in Portugal, suggests a model for the formation of the heritage tourism product. This author examines the role that coordinated marketing plays in successful advertising through the Internet for the promotion of a new cultural heritage product. He finds that there is a high positive correlation between the level of marketing coordination between regional and local agencies and

positioning on the Internet, with a synergistic effect such that the benefit obtained through the collaboration of the agents involved in the dissemination of knowledge is much greater than the benefit expected on an individual basis.

5. Conclusions

Cultural heritage is a territorial resource (Carbone, 2016) that enables the social, economic, identity and social cohesion development of territories. The conservation, preservation and enhancement of this heritage implies a transversal and multidisciplinary management of this heritage with the involvement of all actors involved, managers, residents, stakeholders. In this context, the adoption of dissemination strategies based on information and communication technologies (ICTs) have generated, in the last decade, a change of paradigm, which allows users to identify, personalize and exploit cultural heritage (Portalés et al. 2018). ICTs can transform heritage from the domain of specialists to that of a wider public, as well as being a means to boost the economic development of local communities and regions, by strengthening cultural identity and intercultural communication. At the same time, these technologies have produced a wide range of applications for collecting and processing historical data, for documenting and monitoring the conservation of objects and monuments, and for creating interactive information networks that can link professionals and academics with students, museum visitors and anyone interested in cultural heritage (Portalés et al, 2018).

Although there is little work that shows the importance of new tools based on ICTs for the dissemination of cultural heritage, and therefore their power in terms of enhancing it, some examples and studies have been considered that suggest that communication and dissemination strategies should be part of the management of any heritage landmark (Lewi, & Smith, 2016).

Thus, for example, applying the results of the Krakover (2012) and Boivin & Tanguay (2019) studies to the case of Marzameni's underwater heritage, it is clear that an increase in information related to this heritage on the various websites and social networks related to Marzameni as a tourist town would undoubtedly improve knowledge of Marzameni's underwater heritage.

References

- [1] Aaker D A 1991 *Managing Brand Equity Capitalizing on the Value of Brand Name* (New York The Free Press)
- [2] Aznar M J 2018 *J Marit Archaeol* **13** 67-81
- [3] Balletti C, Beltrame C, Costa E, Guerra F and Vernier P 2015 *Proc. SPIE The International Society for Optical Engineering* DOI 10.1117/122184802
- [4] Beltrán M E, Ursa Y de los Rios S, Cabrera-Umpiérrez M F, Arredondo M T, Páramo M and Pérez L M 2014 *Int. Conf. Universal Access in Human-Computer Interaction* (Springer Cham) pp 639-49
- [5] Bjørkelund E, Burnett T H and Nørvåg K 2012 December *Proc. 14th Int. Conf. Information Integration and Web-based Applications and Services* (Bali Indonesia) (ACM) pp 229-38
- [6] Boivin M and Tanguay G A 2019 *Journal of destination marketing and management* **11** pp 67-79
- [7] Bowitz E and Ibenholt K 2008 *J Cult Herit* **101** pp 1-8
- [8] Caldwell N G 2000 *Journal of Arts Management* **23** pp 28-34
- [9] Camarero C, Garrido-Samaniego M J and Vicente E 2012 *The Service Industries Journal* **329** pp 1527-49
- [10] Carbone F 2016 *Eur J Tour Res* **14** pp 75–91
- [11] Carlson D N and Scoward W 2010 *Am J Archaeol* **114** 1 pp 145-59
- [12] *Convention on the protection of the underwater cultural heritage 2001* (UNESCO Paris)
- [13] Cwi D and Lydall K 1977 *The Center for Metropolitan Planning and Research* (Washington DC National Endowment for the Arts Research Division) p 97
- [14] Domínguez-Pérez M and Martín-Fernández J 2015 *Actas del Segundo Congreso Int. de Buenas Prácticas en Patrimonio Mundial* 29-30 de abril 1 y 2 de mayo de 2015 Universidad

- Complutense pp 777-92
- [15] EC 2015b *Getting cultural heritage to work for Europe Report of the Horizon 2020 Expert groups on Cultural Heritage Directorate- General for Research and Innovation*
- [16] Floch J, Jiang S, Beltrán M E, Georganteli E, Koukounis I, Prados B and Arredondo M T 2014 June *Int. Conf. on Universal Access in Human-Computer Interaction* (Springer Cham) pp 681-92
- [17] Giaccardi E 2012 *Heritage and Social Media. Understanding heritage in a participatory culture* (1st Edition Routledge) pp 19-28
- [18] Giaccardi E and Palen L 2008 *Journal of Heritage Studies* **143** pp 281-97
- [19] Greffe X 2004 *J Cult Herit* **53** pp 301-09
- [20] Gregory J 2015 *International Journal of Heritage Studies* **211** pp 22-45
- [21] http://www.regionesciliait/beniculturali/archeologiasottomarina/sez_eventi/marzamemi_2014htm
- [22] <https://marzamemistanfordedu/>
- [23] Cultural Heritage Counts for Europe CHCfE Consortium 2015 <https://bitly/39KwtDx19/12/2019>
- [24] Kim H Stepchenkova S and Yilmaz S 2019 *J Travel Res* **583** pp 440–58
- [25] Krakover S 2012 *Tourism and Development* **17** p 18
- [26] Leidwanger J and Tusa S 2014 *Archaeologia Maritima Mediterranea* **12** pp 103-15
- [27] Leidwanger J and S Tusa 2016 *Archaeologia Maritima Mediterranea* **13** pp 129-43
- [28] Leidwanger J and Greene E 2017 *INA Quarterly* **433/4** pp 8-13
- [29] Leidwanger J Pike SH and Donnelly A 2015 *Proc XI Asmosia conference split 2015 Interdisciplinary studies on ancient stone* (Atetić Poljak D and Marasović K) pp 291-299
- [30] Leidwanger J and Tusa S 2015 *Archaeologia Maritima Mediterranea* **12** pp 103-15
- [31] Lewi Hand Smith W 2011 *Architectural Research Quarterly* **151** pp 69-77
- [32] Lewi H Smith W Murray A and Cooke S 2016 *Historic Environment* **282** pp 12-24
- [33] Liu C R Liu H K and Lin W R 2015 *Journal of Tourism Research* **173** pp 229-38
- [34] Maarleveld T Guérin U and Egger B 2013 *Underwater Cultural Heritage and the Rules of the UNESCO 2001 Convention a Manual UNESCO Paris*
- [35] MACHU Managing Cultural Heritage Underwater Report Nr 1 www.machuproject.eu 2008
- [36] A Maritime Research Project Funded by The European Union Culture 2000 Programme
- [37] *Manual for Activities directed at Underwater Cultural Heritage Guidelines to the Annex of the UNESCO 2001 Convention* 2013 (Maarleveld T J et al) p 351
- [38] Nautical Archaeology Society 2009 *Benchmarking Competence Requirements and Training Opportunities related to Maritime Archaeology* (United Kingdom)
- [39] Oppio A, Bottero M, Ferretti V, Fratesi U, Ponzini D and Pracchi V 2015 *J Cult Herit* **166** pp 779-89
- [40] Pasikowska-Schnass M 2018 Cultural heritage in EU Policies European Parliament http://www.europarl.europa.eu/RegData/etudes/BRIE/2018/621876/EPRS_B RI 2018 621876_EN.pdf
- [41] Portalés C Sebastián J Alba E Sevilla J Gaitán M Ruiz P and Fernández M 2018 *Multimodal Technologies and Interaction* **2 2** pp 28-39
- [42] Prados-Peña M B, Gutiérrez-Carrillo M L and Barrio-García D 2019 *Sustainability* **1113** pp 3516-35
- [43] Repola L, Scotto di Carlo N, Signoretti D and Leidwanger J 2018 *Archaeological Prospection* pp 2599–609
- [44] Repola L, Tusa S, Leidwanger J, Cerrato A, Signoretti D and Memmolo R 2015 *1st Int. Conf. Metrology for Archaeology* (Benevento Italy) October pp 22-23
- [45] Sanz J A and Herrero L C 2006 *Hacienda Pública Española/Revista de Economía Pública* **1783** pp 113-33
- [46] Sykes O and Ludwig C 2015 *European Spatial Research and Policy* **222** pp 9-35
- [47] Trillo C and Petti L 2016 *Procedia Technology* **223** pp 693-97
- [48] Tuan T H and Navrud S 2008 *J Cult Herit* **93** pp 326-37
- [49] Van Balen K 2017 *Remote Sensing and Spatial Information Sciences* **42** pp 713-17

[50] Wright W C and Eppink F V 2016 *Ecol Econ* **130** pp 277-84

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