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## SMART CITIES AND HERITAGE CONSERVATION: DEVELOPING A SMARTHERITAGE AGENDA FOR SUSTAINABLE INCLUSIVE COMMUNITIES

DOI: <http://dx.doi.org/10.26687/archnet-ijar.v11i3.1398>

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### Keywords

cultural heritage; smart cities; intelligent environments; sustainable cities

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- *CNKI: China National Knowledge Infrastructure*
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### Abstract

*This paper discusses the potential of current advancements in Information Communication Technologies (ICT) for cultural heritage preservation, valorization and management within contemporary cities. The paper highlights the potential of virtual environments to assess the impacts of heritage policies on urban development. It does so by discussing the implications of virtual globes and crowdsourcing to support the participatory valuation and management of cultural heritage assets. To this purpose, a review of available valuation techniques is here presented together with a discussion on how these techniques might be coupled with ICT tools to promote inclusive governance.*

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## INTRODUCTION

In recent decades, our world has witnessed a constant upwardly trend in urbanization. Most of the world's population (54%) is currently concentrated in urban areas and this percentage is projected to rise to 66% by 2050 (UN, 2014). Such a trend places excessive pressure on the fragile cultural heritage of cities, and may escalate to irreversible damage and ultimate loss. Historic cities in both developed and developing countries possess assets of both cultural and economic value, with strong potential for sustainable growth. Urban heritage and urban landscapes are essential resources for sustainable human development, economic growth and job creation, therefore their protection is not only a moral need but also a necessary financial investment to progress towards the creation of inclusive and sustainable cities (Fusco Girard, 2013; Angrisano et al., 2016).

In the last few years, a multifaceted debate has spurred around the concept of “smart cities” (Batty et al., 2012). Undoubtedly, the Internet of Things (Zanella et al., 2014) is changing the way we live and plan our connected world and recent advancement in technologies might help the development of a new framework able to support heritage-led policymaking in smart cities, in other words, a novel *smartheritage agenda*. Information technologies can respond to the need to promote inclusive, participative governance to support heritage centred sustainable urban development and economic growth.

The paper reflects on the nexus between smart technologies, heritage conservation and the progress towards inclusive, sustainable cities and communities. The paper explores the role that the conservation of cultural heritage can have in the progress towards UN Sustainable Development Goals (SDGs) (UN, 2015) and highlights the necessity of a coordinated *smartheritage* approach, focusing on the potential of intelligent environment for the economic assessment of cities' cultural heritage (Riganti & Nijkamp, 2006).

The structure of the paper is as follows: first, the nature of cultural heritage is discussed in the context of contemporary cities; second, the economic dimension of cultural heritage is argued together with the economic valuation techniques needed to assess the value of cultural heritage; third, an intelligent environment for cultural heritage management is presented within the context of smart cities.

## CITIES, RAPID URBANIZATION TRENDS, CULTURAL HERITAGE AND POLICY MAKING

Contemporary cities face unique challenges, whose solutions might lie in more innovative ways of using smart technologies in support of decision-making. The geographies of regions are changing, due to recent immigration phenomena, often linked to important socio-economic problems (e.g. terrorism, armed conflicts, lack of jobs or resources, extreme poverty, ethnic contrasts) and/or environmental ones (e.g. environmental hazards, climate change). People move towards new territories that might be more secure, productive, economically stable and socially inclusive. Terrorism's attacks together with the displacement of populations have caused the surge of nationalism and of roaring intolerance.

Cultural diversity, which in the previous decade had been studied as a positive phenomenon (Ottaviano & Peri, 2006; Putnam, 2007) is now seen as a peril and people nurture suspicion for what is considered different, other from us. Spreading intolerance and nationalism are making the integration process more difficult in many countries of the world. Different forms



of sectarianism and social conflicts are present in both developed and developing countries. Within this scenario, heritage plays a strategic role in peace building and overcoming divisions (UNESCO, 2017; G7, 2017). In fact, cultural heritage, in both its tangible and intangible expressions, summarizes people's identities, shapes communities' ones, and contributes to the creation of social capital (Coleman, 1988; Portes, 1998). The loss of heritage has to be avoided; its purposeful destruction at the hand of terrorists has been recently declared a war crime (International Criminal Court, 2015); and its conservation calls for coordinated actions. Within this debate, understanding the value that heritage has for a community is becoming crucial.

The preservation of cultural heritage implies a valuation process. Labelling something as heritage constitutes a value judgment, distinguishing a specific object/event from others; it is a conscious act of belonging to a group, a city, a nation and the outcome of an important cultural journey (Riganti, 2010). The debate around the definition of heritage as cultural capital (Throbsy, 1999) highlights important research questions that this paper aims to address. What is the value of cultural heritage? How can we express the total economic value of goods that are not exchanged in the market? Can the economic valuation of heritage goods help their management and conservation? How can the progress in smart technologies, combined with the participatory valuation of cultural heritage, support policymaking? The following two sections discuss the concept of cultural heritage as an economic good and the potential of valuation methods to enhance participation in heritage management.

## **CULTURAL HERITAGE AS AN ECONOMIC GOOD**

Cultural heritage can be defined as the ensemble of tangible and intangible assets, which hold cultural, artistic or architectural significance to society at large (UNESCO, 1972). It may include monuments, artistic expressions, landscapes, and even traditions, languages, and dances.

From an economic perspective, cultural heritage has a collective nature and it is essentially a club good (Buchanan, 1965), although this aspect has been debated in literature and is not fully agreed upon. The ownership rests with society, which may decide on the access conditions, though in principle, no citizen can be excluded from its use.

As an economic good, cultural heritage shows some important anomalies, since usual market conditions do not hold. In fact, there is no clear production function (at least not in the short run, though the current production - architectural or artistic - might become the heritage of the future) and its demand curve is often latent. Cultural heritage it is usually unique in nature and sometimes difficult to substitute, even though in principle its loss could be compensated. People gain a utility just by knowing of its mere existence (existence value) or by the fact that they may preserve it for future generations (bequest value) (Nijkamp & Riganti, 2009).

## **ECONOMIC VALUATION METHODS FOR INCLUSIVE HERITAGE MANAGEMENT**

Assessing the value that the public attach to cultural heritage represents a crucial step toward its participatory management. This section discusses some of the main economic valuation methods used to elicit the economic value of heritage goods.



The need to manage heritage as an economic resource is implicit in the definition of cultural heritage as cultural capital (Throsby, 1999). From an economic point of view, we need to understand the relationship between demand and supply. In the case of cultural heritage, the supply side is relatively fixed, and the demand side is often latent (Navrud & Ready, 2002). Economists have circumvented the latter problem by developing new economic valuation techniques (Navrud & Ready, 2002; Nijkamp & Riganti, 2009).

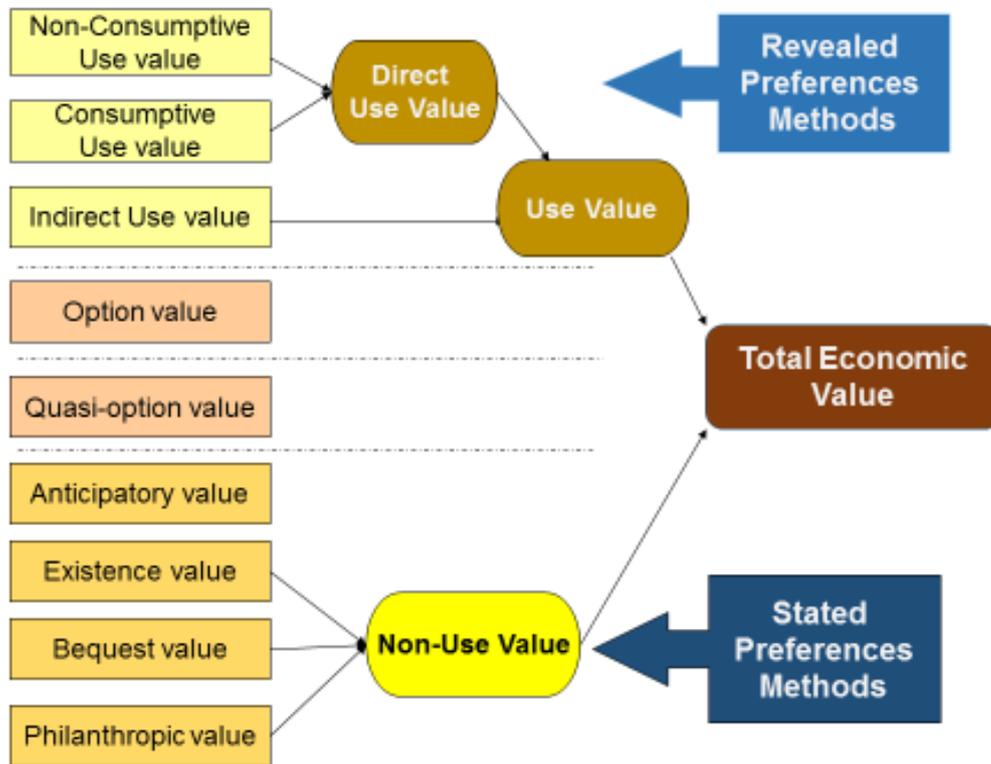


Figure 1. Assessment methods and economic values (Source: Nijkamp and Riganti, 2009).

As portrayed in Figure 1, two main approaches are used to assess people’s preferences: one looks at the way people have behaved in the market (revealed preferences techniques), whilst the other looks at the way people state they would behave in a future (hypothetical) market (stated preferences methods). Non-market goods, such as cultural and environmental ones, have a total economic value (TEV) encompassing both use and non-use values (see Fig 1). Non-use values relate to the symbolic essence of cultural heritage. The elicitation of any part of the Total Economic Value is not a very easy task, but it becomes more complicated for non-use values.

The method of contingent valuation (CV) directly asks individuals how much they are prepared to pay for specified changes in environmental quality or a future program. In recent years the literature has witnessed an increased use of CV to value cultural resources (Pollicino & Maddison, 2001; Navrud & Ready, 2002). Noonan (2003) summarizes the empirical literature on contingent valuation of cultural goods concluding that CV, when rigorously applied to cultural heritage, can inform management policies. Conjoint choice experiments represent a variant of CV methods, asking people to choose between hypothetical commodities described by specific attributes. This exercise requires people to



make trade-offs between attributes, one of which is typically the cost of the commodity to the respondent (Louviere & Hensher, 1982; Louviere & Woodworth, 1983). Though the applications of such approach to heritage are still limited, it has been successfully implemented to value urban transformations and assess management strategies for tourism purposes (Alberini et al., 2003; Alberini et al., 2006; Riganti, Nese & Colombino, 2006; Riganti & Nijkamp, 2008).

## SMART CITIES AND INCLUSIVE HERITAGE MANAGEMENT: USING INTELLIGENT ENVIRONMENTS

The debate on smart cities is bringing many crucial issues to the forefront, linked with the nature of the big data being collected, the related privacy issues and the way such data could be analysed to improve citizens' quality of life and increase participation for democratic city governance. Decision support systems involving models and tools to achieve proper urban intelligence are still in their infancy (Batty et al., 2012). This section discusses how a specific decision support model (Riganti & Nijkamp, 2006), might be developed considering recent technological and social media advancements, as well as the current debate on smart cities and the Internet of things (Batty et al., 2012; Zanella et al., 2014).

The applications of ICT to cultural heritage in recent decades have mainly focused on the digitalization of cultural goods. Such effort has been commendable, since creating inventories of movable and non-movable heritage assets and goods is an essential part of the conservation process. Preserving the good's physical appearance and integrity, using sustainable intervention techniques, is another main feature of preservation as it is the documentation of any intervention or modification. Storing information about how the good has been transformed was traditionally confined to archives and specialist publications. All this wealth of information has often been barely available, if not completely inaccessible. Debate has to be spurred around the role that intelligent environment could play within the creation, for instance, of urban observatories, as currently promoted in the UK (University of Newcastle, 2017).

Riganti and Nijkamp (2006) described a vision of a future intelligent environment (IE) which would integrate the digital preservation of heritage with its inclusive, participatory management. In 2006, social media platforms were in their infancy and the impact and breath of ICT development as it has occurred in the last decade was unforeseen. At that time, the main advancement in ICT pointed towards the creation of various forms of E-Heritage. Nowadays, the advent of social media, smart phones apps, virtual globes and crowdsourcing (Kefalidou et al., 2012) is changing the way heritage is recorded by locals and tourists.

As noted by Batty et al. (2012), research in this field should aim to develop integrated platforms for city governance. The intelligent environment/decision making support platform proposed by the author in 2006 shows a structure still relevant after more than a decade. An intelligent environment for the management of cultural heritage should be capable of storing and retrieving information on cultural heritage goods, not only for preserving their memory in our digital era but also to monitor *best management practices and public preferences for their exploitation* (Riganti, 2003). Such a platform should address the need for E-governance in the cultural sector, and promote the transfer of cultural heritage management good practices (Riganti & Nijkamp, 2006; Batty et al., 2012). The development of such an integrated



platform should have the potential to combine both the demand and supply side of heritage resources, creating a cyberspace where the two meet and negotiate their priorities.

This integrated platform should account for the economic issues associated to different management strategies, promoting the idea of an information society for all as the shift to a digital, knowledge-based economy, prompted by new goods and services represents a powerful engine for growth, competitiveness and jobs.

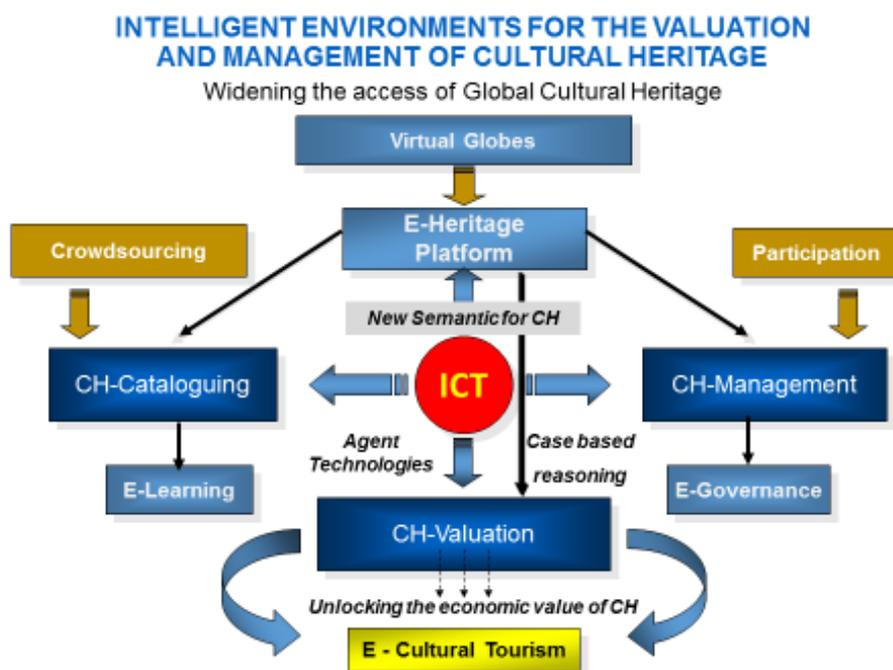


Figure 2. An intelligent environment scenario (Source: adapted from Riganti & Nijkamp, 2006).

Figure 2 summarizes the features that such an Intelligent Environment should have. The above presents a revised version of the Intelligent Environment previously suggested by the author (Riganti & Nijkamp, 2006). The developed platform should be able to gather people's preferences (CH valuation in Fig. 2) for different services and management strategies (CHI management) of diverse categories of cultural goods (CH cataloguing). Two main changes from 2006 are presented: 1) the use of virtual globes for the geo-localization of heritage, and 2) the use of smart apps for the involvement of the public in the appreciation, conservation and management of common heritage (crowdsourcing/participation). These aspects are discussed into more detail in the following section of the paper.

## AN ICT MODEL/INTELLIGENT ENVIRONMENT FOR CULTURAL HERITAGE MANAGEMENT

Developing a comprehensive intelligent environment in support of decision making for cultural heritage is not an easy task and needs to respond to many challenges. Such an ICT model should integrate important dimensions: a *geographical dimension*, since cultural heritage is highly site specific; the appropriate *ICT dimension*, therefore accounting for new advancements in the field, such as the use of intelligent reasoning and agent technologies;

and finally should account for the relevant preferences, i.e. the users' and decision makers' ones, hence have a *user centric dimension* (see Fig. 2). This last aspect is highly relevant to achieve a participatory management of cultural assets and progress towards the achievement of SDG 11: *sustainable cities and inclusive communities*. The integration of the above dimensions should allow further integration with specific software/apps dedicated to elicit users' preferences by means of online surveys.

The two main aspects that the revised IE (Fig. 2) has introduced with respect to the previous version published in 2006 are *virtual globes* and *crowdsourcing*. Although these additions do not represent a dramatic shift from the original IE vision, the implementation of such changes has some important implications. An IE/DSS would need to address and resolve important issues related to problems of information privacy, data sharing, where such a DSS should be hosted, and how it could be interfaced with urban observatories. How virtual globes and crowdsourcing could be used to progress towards a more inclusive governance of cultural heritage are other issues.

The cultural heritage sector has witnessed important technological advancement in recent years. First, the emergence of virtual environments reconstructing cultural or archaeological sites or proposing a virtual representation of cultural artefacts. Augmented Reality (AR) has also been used to combine digital information with the real and physical environment. The development of 3D games to enhance cultural experiences is another important aspect of the digital revolution taking place in the cultural arena. Finally, the use of Smart Phones (SPs) to capture peoples' experiences while traveling, through taking photos, digital notes, video and voice records and pathways mapping, is a novel aspect that has changed the way narratives around heritage could be gathered and recorded. This constitutes the crowdsourcing aspect important for a participatory management of heritage assets. Crowdsourcing involves the acquisition of information from online communities or the public, often tourists visiting a site or residents. Crowdsourcing is the expression of an active participation by members of the public sharing information on sites and personal experiences of cultural heritage. This has the potential to enhance collaboration among the public and operators promoting creativity and innovation (Oomen & Aroyo, 2011).

The development of *virtual globes* (Brovelli et al., 2013a) is another essential technological development that has taken place over the last decade. Virtual globes have been inspired by the visionary idea of Digital Earth (Gore, 1999). Unlike the traditional 2D-visualization typical of Geographic Information Systems (GIS), they offer a 3D, fully-realistic content visualization allowing for a richer user experience. They have been made possible by the great progress in geo-technologies, and have changed the way people access geographic information on the Web. There are several virtual globes available, and NASA has made their *World Wind* virtual globe openly accessible on the web. In the last few years, several applications to cultural heritage have been developed using World Wind (Brovelli et al., 2013b). This idealistic view of creating an open platform for heritage mapping built upon a unifying, open virtual globe, marries very well with the transnational ethos of the ICT environment previously proposed (Riganti & Njikamp, 2006). This has to be combined with an open data policy supporting an open platform enabling others to reuse information without any restrictions. This could potentially catalyse innovation and overcome the barriers to digital opportunities for all.

The proposed/revised intelligent environment discussed here would provide a national and regional (potentially transnational) database for the preservation and management of cultural heritage. All local information on cultural heritage objects, as well as its virtual representation,



public narratives etc, would be geographically referenced within the GIS infrastructure. This IE would record public preferences for alternative management options for the site, as proposed by the relevant authorities, by using Smart phones apps or online systems. This will provide decision makers with an important decision support system.

This Intelligent Environment would be an *integrated platform*. This integration would refer to three major components: an *ICT architecture*, based on the use of advanced information techniques such as agent technologies; which would be linked to a *3D GIS relational database/virtual globe* containing all the relevant information on the site and its cultural heritage. Finally, the combination of these two components would be enriched by a number of *users driven software/apps*, providing *e-services* to enhance the access and appreciation of cultural destinations and their heritage, as well as software for online valuation of public preferences for the way such heritage is presented/managed/used (see Fig. 2). The final product should be adaptable to accommodate future improvements. The wealth of information would be stored by the ICT architecture, and then, by means of agent technologies and case-based reasoning, it would be provided, in a way relevant to their own specific interest, to different stakeholders as potential users of the integrated platform. They can be decision makers, citizens, tourists, academics, travel agents, tour operators, small firms and business, or people working in the hospitality sector.

As proposed by the 2006 model, the GIS dimension would make all collected information and especially all monitored preferences relevant at local level, whilst making them available for comparisons at regional, national and international level. This could create a national or a European geographical database to implement benefit transfer of cultural values, an operation that has encountered diffidence (Navrud & Ready, 2002), but whose potential has been acknowledged (EFTEC, 2005; Riganti & Nijkamp, 2007), but not much progressed so far. This aspect is potentially crucial to support decision-making in the cultural sector and transfer economically sound and viable management practices.

## SMART CITIES AND HERITAGE CONSERVATION: A SMARTHERITAGE AGENDA

The concept of smart cities has been widely debated in recent years (e.g. Batty et al., 2012; Zanella et al., 2014). How the use of urban observatories, the use of sensors and the collection of big data can help develop safer, more prosperous, inclusive cities, is still a topic of debate. In particular, the role that heritage can play in all this remains unclear.

The proposed Intelligent Environment could address most of the above concerns and the international debate about the SDGs, and provide an impetus for action in urban development and heritage preservation.

A *smartheritage* vision for contemporary cities should account for the following main points:

- The development of Smart solutions (from tailored apps to sensors generating real time data). These should be integrated into:
- A user-friendly platform/GIS-based intelligent environment based on agent technologies, to help customize contents for different communities of users (e.g. academics, policy makers and citizens).
- An open heritage-mapping platform, building upon a unifying, open virtual globe, OpenCitySmart, with an API for functionalities.



- This global platform should have an initial suite of functionalities, including high-level definition 3D visualization and real time data, based on the success stories of some municipalities in Italy (Brovelli et al., 2013a).
- Such functionalities might use, for instance, the NASA World Wind globe.

A *smartheritage* agenda should focus on the development of such open access ICT infrastructures. However, this vision based on the concept of open and common knowledge, whilst incorporating the main progress in terms of crowdsourcing and virtual globes, brings some challenges in terms of privacy of data and willingness of policy makers to cooperate beyond the national (or at times even state/regional) boundaries.

## CONCLUSIONS

This paper has presented a revised model of a previously developed GIS-based Intelligent Environment to support decision making for the sustainable management of cultural heritage. The main argument of the paper is that in order to achieve an inclusive, participatory governance of heritage assets it is necessary to understand the value attached by various stakeholders, in particular local communities, to heritage goods. Such an evaluation of the economic dimension of cultural goods is an important aspect that needs to be incorporated within any ICT environment in order to progress towards SDG 11: sustainable cities and inclusive communities. In fact, a city that does not appropriately value and preserve its heritage is neither sustainable nor resilient.

Making the best of advancements in information technologies and social media is a necessary step to develop a *smartheritage* agenda for cities in both developed and developing countries. A *smartheritage* agenda could consist of a policy framework in the first stage, but eventually needs to be articulated into a proper ICT intelligent environment to support policy making related to the various risks that heritage faces in contemporary cities.

World Heritage has been at risk of destruction in various instances during human history. Natural catastrophes as well as man-caused events have threatened our physical heritage several times in the past and will do so again in the future. Whilst some events cannot be avoided others could, and we should make sure that strategies are put in place in order to contrast them. Assessing the social and economic costs associated to heritage loss is a first step towards finding a better way to manage risk and its consequences. With a great part of the world population living in our contemporary cities, and a constant upward trend towards urbanization, scientists need to integrate disperse knowledge and face the new challenges posed to cities' sustainable development during these times of global economic and political crisis.

Decision Support Systems (DSS) need to account for public preferences on the way heritage sites are managed. Understanding the values that people attach to cultural goods is an important step towards their sound management and therefore towards the minimizations of the risks heritage faces. The economic assessment of the risks brought to heritage needs a holistic approach, given its complexity. However, techniques such as choice experiments and contingent valuations have great potential to assist this process.

More research is needed to explore ways of addressing the risks faced by our world heritage. An intelligent environment, based on an open data approach, would be an ideal support for policy makers. Many, if not most, of the challenges facing the cities of today are quite similar



in nature if not identical: from infrastructure management to essential public services. If the cities of the world were to share best practices with each other, they could each focus on different parts of the problem and progress would be quicker.

This paper has highlighted the need to create new synergies between academic approaches and disciplines, while focusing on the important role played by the economic valuation of urban cultural heritage at risk in its various (tangible and intangible) forms. In order to protect our heritage, we need to link transversally diverse issues such as cultural diversity, migration phenomena, city identity and branding, city governance and management, cultural heritage conservation, cultural tourism management, climate change challenges to cultural heritage, and identity/cultural heritage preservation in armed conflicts and in their aftermaths. At a time when nationalism and terrorism bring division and separate communities, heritage has the potential for peace building and the digital era could make the world feel not only smaller, but also more united (UNESCO, 2017).

## ACKNOWLEDGEMENTS

The author is grateful to Luigi Fusco Girard and Peter Nijkamp to have stimulated her reflection on the issues described in this paper, though at different points in time. The author wishes to thank Prof David Bell, Queen's University Belfast. His visionary takes on the future of Computer Science for heritage assets was highly inspiring during our discussions of more than decade ago and have never been forgotten since. All errors remain solely responsibility of the author.

## REFERENCES

- Alberini A., Riganti, P., & Longo, A. (2003). Can People Value the Aesthetic and Use Services of Urban Sites? Evidence from a Survey of Belfast Residents. *Journal of Cultural Economics*, 27, 3-4.
- Alberini, A., Longo, A., & Riganti, P. (2006). Using Surveys to Compare the Public's and Decision-makers' Preferences for Urban Regeneration: The Venice Arsenale. The Fondazione Eni Enrico Mattei, Note di Lavoro Series, Inde. Retrieved from <http://www.feem.it/Feem/Pub/Publications/WPapers/default.htm>.
- Angrisano, M., Biancamano, P.F., Bosone, M., Carone, P., Daldanise, G., De Rosa, F., Franciosa, A., Gravagnuolo, A., Iodice, S., Nocca, F., Onesti, A., Panaro, S., Ragozino, S., Sannicandro, V., & Fusco Girard, L. (2016). Towards operationalizing UNESCO Recommendations on "Historic Urban Landscape". *Aestimum* 69, December 2016.
- Batty, M., Axhausen, K., Fosca, G., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., & Portugali, Y. (2012). Smart cities of the future. *The European Physical Journal, Special Topics* 214, 481–518.
- Brovelli, M.A., Minghini, M., & Zamboni, G. (2013a). Participatory GIS: Experimentations for a 3D Social Virtual Globe. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XL-2/W2.
- Brovelli, M. A., Hogan, P., Minghini, M., & Zamboni, G. (2013b). The power of Virtual Globes for valorising cultural heritage and enabling sustainable tourism: NASA World Wind applications. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XL-4/W2, 115–120.
- Buchanan, J.M. (1965). An Economic Theory of Clubs. *Economica*, 32, pp. 1-14.
- Coleman, J. (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology*, 94, Supplement S95-S120. University of Chicago.
- EFTEC. (2005). Valuation of the Historic Environment. Report to English Heritage. London: Heritage Lottery Fund, Department for Culture, Media and Sport, Department for Transport.



- Fusco Girard, L. (2013). Toward a Smart Sustainable Development of Port Cities/Areas: The Role of the “Historic Urban Landscape” Approach. *Sustainability* 5, 2013, 4329-4348. doi:10.3390/su5104329. ISSN 2071-1050.
- Gore, A. (1999). The Digital Earth: understanding our planet in the 21st century. *Photogrammetric Engineering and Remote Sensing*, 65(5), pp. 528.
- G7. (2017). Culture as An Instrument For Dialogue Among Peoples. Joint Declaration of The Ministers of Culture of G7 On the Occasion of The Meeting. Florence: Ministers of Culture of G7, March 2017.
- International Criminal Court (2015). Case No. ICC-01/12-01/15, Prosecutor v. Ahmad Al Faqi Al Mahdi.
- Kefalidou, G., Mercurios, G., Bryn, A. C., & Suchith, A. (2012). Crowdsourcing Our Cultural Heritage. In: Clare Mills, Michael Pidd and Esther Ward. Proceedings of the Digital Humanities Congress 2012. Studies in the Digital Humanities. Sheffield: HRI Online Publications, 2014. Retrieved from <https://www.hrionline.ac.uk/openbook/chapter/dhc2012-kefalidou>.
- Louviere, J., & Hensher, D. A. (1982). On the Design and Analysis of Simulated Choice or Allocation Experiments in Travel Choice Modeling. *Transportation Research Record*, 890, 11-17.
- Louviere, J., & Woodworth, J. N. (1983). Design and Analysis of Simulated Consumer Choice of Allocation Experiments: An Approach Based on Aggregate Data. *Journal of marketing Research*, 20, 350-367.
- Navrud, S., & Ready, R. (2002). Valuing Cultural Heritage, Edward Elgar Publishing, UK.
- Nijkamp, P., & Riganti, P. (2009). Valuing Urban Cultural Heritage. In P. Nijkamp & L. Fusco Girard (Eds.), Cultural Heritage, Local resources and sustainable tourism. UK: Ashgate, Aldershot, February 2009.
- Noonan, D.S. (2003). Contingent Valuation and Cultural Resources: A Meta-Analytic Review of the Literature. *Journal of Cultural Economics*, 27(3-4) 159-176.
- Oomen, J., & Aroyo, L. (2011). Crowdsourcing in the Cultural Heritage Domain: opportunities and challenges. In: C&T '11 (Eds.), Proceedings of the 5th International Conference on Communities and Technologies 2011. 138-149.
- Ottaviano, G.I.P., & Peri, G. (2006). The economic value of cultural diversity: evidence from US cities. *Journal of Economic geography*, 6(1), January 2006.
- Pollicino, M. & Maddison, D. (2001). Valuing the Benefits of Cleaning Lincoln Cathedral. *Journal of Cultural Economics*, 25(2), 131-148.
- Portes, A. (1998). Social Capital: Its Origins and Applications in Modern Sociology. *Annual Review of Sociology* (24),1-24.
- Putnam, R. D. (2007). E Pluribus Unum: Diversity and Community in the Twenty-first Century The 2006 Johan Skytte Prize Lecture. *Scandinavian Political Studies*, 30, 137–174.
- Riganti, P. (2003). Assessing Public Preferences For Managing Cultural Heritage: Tools And Methodologies. In Official Publication Office of the European Commission (Eds.), Cultural Heritage Research: a Pan European Challenge. Luxembourg.
- Riganti, P., & Nijkamp, P. (2006). The Value of Urban Cultural Heritage: An Intelligent Environment Approach. *Studies in Regional Science*, 36 (2).
- Riganti, P., Nese A., & Colombino, U. (2006). A Methodology for Eliciting Public Preferences for Managing Cultural Heritage Sites; An Application to the Temples of Paestum. In M. Giaoutzi & P. Nijkamp (Eds.), Tourism and Regional Development (pp 201- 216). UK: Ashgate, Aldershot.
- Riganti, P., & Nijkamp, P. (2007). Benefit transfer of cultural values: Lessons from environmental economics. *Journal of Environmental Law and Policy*, 2, 2/2007, 135-148.
- Riganti, P., & Nijkamp, P. (2008). Congestion in Popular Tourist Areas: A Multi-Attribute Experimental Choice Analysis of Willingness-To-Wait in Amsterdam. *Tourism Economics*, 14, 1, March 2008, pp. 25-44.
- Riganti, P. (2010). Cultural capital, local identities and ethnic diversity: A study of Amsterdam cultural tourism trends. In M. Janssens, M. Bechtoldt, G. Prarolo & V. Stenius (Eds.), Sustainable Diversity. Edward Elgar.
- Throsby, D. (1999). Cultural Capital. *Journal of Cultural Economics*, 23, pp. 3-12.
- UN. (2014). World Urbanization Prospects. The 2014 Revision Highlights. New York: Department of Economic and Social Affairs.

- UN. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. New York.
- UNESCO. (1972). *Convention Concerning the Protection of the World Cultural and Natural Heritage*. Paris: Unesco.
- UNESCO. (2017). *Unite4Heritage Partnership*. Paris: Unesco.
- University of Newcastle upon Tyne. (2017). *Urban Observatory*. Retrieved from <http://www.research.ncl.ac.uk/urbanobservatory>, Access Date, 12/06/2017.
- Zanella, A., Bui, N., Castellani, A., Vangelista L., & Zorzi, M. (2014). *Internet of Things for Smart Cities*. *IEEE Internet of Things Journal*, 1(1), February 2014.