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Geoinformatics for the conservation and promotion of cultural heritage in support of the UN Sustainable Development Goals

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ABSTRACT

Cultural Heritage (CH) is recognised as being of historical, social, and anthropological value and is considered as an enabler of sustainable development. As a result, it is included in the United Nations' Sustainable Development Goals (SDGs) 11 and 8. SDG 11.4 emphasises the protection and safeguarding of heritage, and SDG 8.9 aims to promote sustainable tourism that creates jobs and promotes local culture and products. This paper briefly reviews the geoinformatics technologies of photogrammetry, remote sensing, and spatial information science and their application to CH. Detailed aspects of CH-related SDGs, comprising protection and safeguarding, as well as the promotion of sustainable tourism are outlined. Contributions of geoinformatics technologies to each of these aspects are then identified and analysed. Case studies in both developing and developed countries, supported by funding directed at the UN SDGs, are presented to illustrate the challenges and opportunities of geoinformatics to enhance CH protection and to promote sustainable tourism. The potential and impact of geoinformatics for the measurement of official SDG indicators, as well as UNESCO's Culture for Development Indicators, are discussed. Based on analysis of the review and the presented case studies, it is concluded that the contribution of geoinformatics to the achievement of CH SDGs is necessary, significant and evident. Moreover, following the UNESCO initiative to introduce CH into the sustainable development agenda and related ICOMOS action plan, the concept of Sustainable Cultural Heritage is defined, reflecting the significance of CH to the United Nations' ambition to "transform our world".

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1. Introduction

1.1. Cultural heritage and the UN Sustainable Development Goals

In September 2015, the United Nations (UN) adopted 17 Sustainable Development Goals (SDGs) to transform our world by 2030 (United Nations, 2015). Prior to this development, in 2013, the United Nations Educational, Scientific and Cultural Organization (UNESCO) had already declared that culture should be at the heart of sustainable development policies (UNESCO, 2013b), and cultural heritage (CH) was introduced into the Sustainable Development Agenda. Subsequently, in November 2015, the 20th General Assembly of the States Parties to the World Heritage Convention adopted a Policy on the integration of a sustainable development perspective into the processes of the World Heritage Convention (UNESCO, 2015). UNESCO thereafter launched the Culture for Sustainable Urban Development programme (UNESCO, 2016a) to emphasize the role of culture in sustainable development, and illustrate the link between the implementation of the UNESCO Culture Conventions and the achievement of the SDGs. CH is therefore now considered as a critical enabler of sustainable development, and is both directly and indirectly reflected in the SDGs.

The UNESCO World Heritage and Sustainable Development Programme[1] outlines the potential positive contributions that appropriate CH conservation and management can make to sustainable development. Firstly, a well-protected heritage property may

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[1] http://whc.unesco.org/en/sustainabledevelopment/.

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contribute directly to the richness of the living environment for present and future generations. Secondly, the preservation of natural resources, including archaeological sites, is fundamental to environmental sustainability. Thirdly, heritage is an important asset for economic development, since it can help attract investments and ensure green, local, stable and respectable jobs, some of which may be related to tourism. Fourthly, heritage is essential to the spiritual wellbeing of people for its powerful symbolic, aesthetic and religious dimensions. Fifthly, well-maintained heritage is important in addressing risks related to natural and manmade disasters. Moreover, heritage related activities help people recover a sense of continuity, dignity and empowerment.

The importance of heritage for sustainable development is addressed specifically in two of UN SDGs. Under SDG 11, "Make cities inclusive, safe, resilient and sustainable", SDG 11.4 emphasises the requirement to "Strengthen efforts to protect and safeguard the world's cultural and natural heritage" so that it can continue to benefit people, as mentioned. However, economic necessity often exceeds cultural needs, especially in developing countries, and CH may be exploited to encourage tourism as a major source of income. Finding a sustainable balance between the economic exploitation of a CH site and its preservation therefore becomes a crucial challenge. For such reasons, the UN SDGs also aim to promote sustainable tourism under SDG 8.9, "By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products".

As defined by the UNESCO Convention concerning the protection of the world heritage (UNESCO, 1972), heritage is divided into cultural and natural heritage. Physical objects, such as monuments, architectural buildings, sculptures, paintings, and archaeological sites, are considered as CH. Natural heritage refers to sites of natural features including physical, biological, geological, and physiographical formations that of outstanding universal value from the point of view of science, conservation or aesthetics. There are also sites of mixed character, hence the world heritage list includes cultural, natural and mixed sites.[2] This paper primarily addresses the significant role of geoinformatics in CH, even though it has also been intensively used for environmental and natural heritage conservation and management.

The meaning of the term "cultural heritage" has evolved considerably in recent decades, partly due to instruments developed by UNESCO. CH no longer ends at monuments and collections of historical artefacts, which are now referred to as tangible CH, but also includes traditions or living expressions inherited from our ancestors and passed on to our descendants. This is defined as intangible cultural heritage (ICH), which includes oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe, and the knowledge and skills to produce traditional crafts (UNESCO, 2003). This paper demonstrates the application of geoinformatics to both tangible and intangible CH, and discusses the recent developments and trends in CH conservation.

The UN Statistical Commission (UNSC) created an Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) to propose a global indicator framework (UNSC, 2015) as a guidance to measure the achievement of the SDGs. For SDG 11.4, the indicator is 'the total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage'. Expenditure includes operating cost and investment spent on different types of heritage from various levels of government and types of private funding. The indicators for SDGs 8.9 are the 'tourism direct GDP as a proportion of total GDP and in growth rate' and the 'proportion of jobs in tourism industries out of total tourism jobs'.

Aside from the IAEG-SDGs, UNESCO has also proposed its own Culture for Development Indicators (CDIs) (UNESCO, 2014a), covering seven key policy dimensions and including 22 indicators, which are considered as advocacy and policy tools that assess the multidimensional role of culture in development processes. The CDIs fill a critical gap when advocating the significance of the role for culture within the SDGs. The Heritage Dimension, one of the seven policy dimensions, examines the establishment and implementation of a multidimensional framework for the protection and promotion of heritage. The core indicator is heritage sustainability, which comprises three major interrelated components, including 'registrations and inscriptions', 'protection, safeguarding and management', and 'transmission and mobilization of support'.

The world's heritage is under both natural and anthropogenic threat, which hinders the achievement of the SDGs. The International Council on Monuments and Sites (ICOMOS) analysed the threats to heritage sites from 1994 to 2004 (ICOMOS, 2005). Eight main categories of threat were identified, namely deterioration, development, extraction of resources, large-scale development projects, tourism, local on-site management deficiencies, cultural changes or deficiencies, and socio-economic-national infrastructure context. More recently, ICOMOS presented a concept note for 'Cultural heritage, the UN Sustainable Development Goals, and the New Urban Agenda' (Hosagrahar et al., 2016) addressing contemporary issues in urban heritage conservation, including urbanization, globalization and loss of identity, tourism, disasters, change in local communities, inadequate urban planning, urban ecology, and awareness of cultural rights.

In general, the threats to cultural heritage, tangible or intangible, are multidimensional and complicated. This poses great challenges to the safeguarding of CH and sustainable tourism. For example, CH sites have often been developed as tourist attractions due to the benefit of creating job opportunities and promoting local culture. However, even though tourism can promote indigenous products to the short-term benefit of local economies, it can also accelerate the deterioration of the exploited CH structures or sites. Natural disasters pose severe threats to CH. Recent earthquakes in Nepal (Dangal, 2015) and Italy (Chiabrando et al., 2016), for example, have damaged and even destroyed many important historic structures. Subtle environmental changes also affect CH in a slow but continuous manner. Climate change aspects, including atmospheric moisture variation, temperature increase, sea level rise, wind, desertification, and pollution, together with biological and geological factors are having physical, social and cultural impacts on CH (Sabbioni et al., 2009; Cassar and Pender, 2005; Hall et al., 2016; Brimblecombe, 2014). Therefore, heritage sites, in both urban and natural environments, suffer from human conflicts, development, deterioration, environmental impacts, tourist exploitation and mismanagement.

Fig. 1 summarises the role of CH in the SDGs, and the indicators from both the UN and UNESCO, as well as the threats that challenge sustainable conservation and promotion of CH. This paper will briefly discuss the use of geoinformatics in the field of CH, and focus on how it is contributing to helping achieve the CH-related SDGs.

1.2. Geoinformatics technologies in cultural heritage

Geoinformatics technologies, including photogrammetry, laser scanning, remote sensing, web-mapping, and geospatial data science, have long played an important role in CH documentation and preservation (Remondino and Rizzi, 2010; Pieraccini et al., 2001; Barber et al., 2006; Levoy et al., 2000). In this section, the

[2] http://whc.unesco.org/en/list/.

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