Introduction

The present work is the result of research carried out from 2013 to 2018, in the framework of research projects carried out with the Università degli Studi di Napoli "L'Orientale" (i.e. International project 3D-ICONS, which saw as leading partner CISA – Centro Interdipartimentale di Servizi di Archeologia) and with the Dipartimento di Scienze del Patrimonio Culturale (DiSPaC) of the Università di Salerno, where the writer obtained her PhD degree.

The documentation process in the archaeological field has significantly improved thanks to the dissemination of technologically sophisticated investigation methods. Such technologies, already employed in commercial contexts, enable faster operations and unprecedented accuracy of representation.

Although, these new techniques offer ground-breaking opportunities for academic research, their full potential has not yet been exploited. This may be because, a simple 3D survey of a monument, even if extremely accurate, is not enough to obtain good scientific results.

Unfortunately, archaeologists are not always familiar with computer graphics innovations and rarely with Computational Archaeology. This results in a lack of systematization of methodological procedures and, in most cases, the accumulation of high-quality data is not fully exploited.

The collapses of archaeological areas in Pompeii and Rome have created great media clamour around the world. However, beyond the public outrage, they also highlighted the important need to develop new ways to protect Italian archaeological heritage

With this in mind, in 2011, the *Ministero dei Beni e delle Attività Culturali e del Turismo*, approved an extraordinary project, within the Great Pompeii Project (GPP)[1]. Its focus would have been the conservation and the enhancement of this archaeological area following a new methodology. which had been successfully tested in some other archaeological areas. It is the development of innovative methodologies that has inspired this work. In particular, as the methodology from the GPP project is now been inserted in the "Linee guida per la conservazione del patrimonio archeologico".

These guidelines which are examined by the *Consiglio Superiore dei beni culturali e paesaggistici* are based

on the innovative concept of "planned maintenance". Planned maintenance provides for systematic collection of information about assets and timely drafting adequate conservation plans.

The guidelines also touch on data collection through a project called "Knowledge Plan". The plan proposes arranging prior information in a single information system and integrating it with new (digital) data extracted from three-dimensional surveys. This new data is made with instruments capable of analytically documenting any type of monument, object or masonry.

The Knowledge Plan represents an innovative approach to the protection of cultural heritage. It enables the surveying of materials and structures' state of deterioration, while simultaneously collecting, archiving and managing the data. This approach is essential to better understand archaeological heritage, monitor how its state of conservation evolves and assess the sustainability and safety of maintenance plans.

This Knowledge Plan applies an innovative and expeditious surveying method, the three-dimensional digital survey, to heterogeneous information (e.g. identification and consistency of materials, surveys, studies, analysis results, archival documentation, previous interventions, etc.). This survey method is performed with laser-scanning or photogrammetric methods.

The 1972 Restoration Charter already defines a specific and widely tested procedure for the conservation and restoration of artistic assets, which often requires considerable investment (analysis, training of specialized workers, adaptation of scientific and non-scientific technical personnel). However, it has not yet clarified a unique methodology for the "knowledge" of artistic assets, to be understood as a systematic collection of documentation.

The Knowledge Plan, when implementing information gathering procedures, highlighted the importance and multiplicity of uses of three-dimensional surveying. However, it did not expand in detail regarding the various management issues.

Certainly, Pompeii represents a privileged site for the development of 3D acquisition methodologies. In recent years, the SIAV – Vesuvius Archaeological Information System and the "archaeological risk monitoring map 2010-2011" systems have been developed to monitor this archaeological site. However, although these systems propose two complementary approaches, they cannot

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[1] Approved on 29 March 2012 by the European Community.

immediately dialogue with each other[2]. Another project worth mentioning on new interesting ideas for the arrangement of the data is the Herculaneum Conservation Project[3]. This project deals with the conservation of the nearby Vesuvian city of Herculaneum, which although smaller in scale is comparable to Pompeii in complexity[4].

The aim of this work is to suggest, through direct experimentation, 3D methodologies that satisfy the most common archaeological requests. I will be doing this by applying these methodologies to real cases that are representative of different research macro-topics. In particular, I will analyse (i) the potential of these innovative investigation methodologies and how critical they are, (ii) the difficulties of managing the data obtained (big data) and (iii) the interoperability with archaeological activities such as excavation, conservation and enhancement.

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[2] Cinquantaquattro 2011
[3] http://www.herculaneum.org
[4] Thompson, D'Andrea 2009