INTRODUCTION

Cultural Heritage is an expression of the ways of living developed by a community and passed on from generation to generation, including customs, practices, places, objects, artistic expressions and values. Cultural Heritage is often expressed as either Intangible or Tangible Cultural Heritage (ICOMOS, 2002).

For this reason with the term “cultural heritage” we can conjure up the idea of a society and the communication between its members. But the cultural boundaries are not really well-defined. Artists, writers, scientists, craftsmen and musicians learn from each other, even if they belong to different cultures, far removed in space or time. Cultural Heritage can be tangible or intangible.

Tangible Heritage includes monuments, artifacts, buildings, historic places, etc., that have to be considered deserving of preservation for the future. It therefore becomes obvious considering rich in meaning and value to objects that represent the architecture and archeology. All the Archaeological Architectural Heritage, AAH, is fundamental to the study and comprehension of human history because they provide a concrete basis for ideas, and can validate them. Only with their preservation is possible to demonstrate the recognition of the necessity of the past and of the things that tell its story. Only with the preservation of objects is possible to validate memories; and the actuality of the object, as opposed to a reproduction or surrogate, draws people in and gives them a literal way of touching the past. This attitude poses, unfortunately a danger as places and things are damaged by, natural disasters, wars and also to the hands of tourists, the light required to display them, and other risks of making an object known and available. So we have to don’t forget that the reality of the risk reinforces the fact that all artifacts are in a constant state of transformation, so that what is considered to be preserved is actually changing – it is never as it once was. Similarly changing is the value each generation may place on the past and on the artifacts that link it to the past.

Intangible Cultural Heritage refers to things that are not physical items but exist intellectually. Intangible Cultural Heritage includes oral traditions songs, rituals, values, superstitions and myths, beliefs, social practices, and the knowledge and skills to produce traditional crafts.

The goal of the book is to focusing the analysis only to tangible Cultural Heritage. The today development of new and more effective digital technologies, such as 3D integrated survey, allowed the creation of 2D and 3D data to use for the creation of knowledge/building information systems, multimedia techniques, animations and simulations. This new way of managing cultural heritage has opened new scenarios for reading and managing Architectural-Archeological Heritage (AAH), where all the information become available in a visual and integrated way.
Evaluation and preservation of cultural heritage is inextricably connected with the innovative processes of gaining, managing and using knowledge. For several years now, data archiving has been a central issue insofar as works of cultural heritage are concerned. It is precisely in this domain that the methodologies of digital 3D models representation were significantly applied. The ever-growing number of digital models as well as the diversity of processes and objects involved impose the necessity to define new modalities for documentation, managing and sharing of information. In our times it is precisely the techniques and instruments of digitalization that have made possible the large scale production of three dimensional objects belonging to artistic and cultural heritage. Conversion of physical (material) objects into digital ones involves constructing photorealistic 3D models, whose close geometric, metric, structural, chromatic similarity to the real object is necessarily its main and characteristic feature. Models of this type provide a much more effective, articulated and complex representation than others because they can be used as bases to construct cognitive systems. Digital visualization makes possible an integrated interpretation of heterogeneous data and a redefinition of the very concept of representation by linking it to the concept of information. A 3D model can be considered a “vast and structured out information database” (Gaiani, Bendetti & Apollonio, 2011). More 3D models of architectural element systems could compose a 3D database, which would also express relations between them and their location. Digital archives ascribe to 3D models with the information typology that characterize them, heterogeneous data (images, texts, video materials, bibliographical documents) with the purpose to preserve, evaluate and popularize cultural heritage by devising an open system of knowledge.

GENERAL CONSIDERATION ON KNOWLEDGE

Any intervention into matters Architectural-Archeological Heritage (AAH), apart from the scale of the object in question, is based on a structure of a system of knowledge adapted to catching, interpreting and archiving a great number of information. Basically, the components of this system fall into one of the following categories:

- Historical – cultural;
- Quantitative, derived from measurements acquired through surveying;
- Qualitative, whose source lies in the interpretative capacities of the researcher and can be defined as an “act of knowledge (cognition) performed on the measured data.”

The objective being that of managing the research data as correctly as possible and to make the results as objective as possible, it is necessary that all the information belonging to a system of knowledge be based on coherent and rigorous data which meet the criteria of scientifity.

In his analysis of knowledge and cognition René Descartes distinguished normal knowledge, reached only through sense organs from profound knowledge, which the scholar reaches by applying methods and techniques of enquiry that are capable of showing to the mind all that proves inaccessible to the senses (Bianchini, 2012).

Surveying is a tool of profound knowledge of artifacts, a methodology for obtaining an adequate and correct number of information about the real thing. The information gathered have to be structured at
the stage of enquiry, study and interpretation of the object under analysis, by using instruments adapted to the objective which guarantee the possibility of creating of data about text and graphic model closest to the real artifact.

All operations aiming at knowledge of Architectural-Archaeological Heritage (AAH) - whether of objects of urban, architectural or detail scale - must be situated within a frame of reference, be it in relation to the data acquisition methodologies (objective stage) or to the procedures of selecting, elaborating and extracting the obtained data (critical-subjective stage). These features link survey operations to what scholars and researchers refer to as the scientific method, an instrument which considers the set of acquired data as elements that can be subjected to verifications and interpretations.

Once surveying is identified as an instrument of cognition and the assumption is adopted that enquiry, acquisition, selection, interpretation and extraction of data constitute the main stages of any survey, each of these elements will be subjected to the criterion of “falsifiability”.

In this perspective it is important to understand how methodological and procedural issues connected with surveying and representation can be found to correspond to the scientific method with its fundamental principles, i.e.: “any enquiry into a phenomenon is considered scientific if it is performed with a set of techniques based on a collection of data which are observable, empirical and measurable while evincing a definite, controlled and declared uncertainty level; the data must lend themselves to be archived, shared and subjected to independent assessment; the procedures applied have to be replicable in order to be able to gather another set of comparable data” (Bianchini, Borgogni, Ippolito, & Senatore, 2014).

Surveying Architectural-Archaeological Heritage (AAH), whose aim it is to objectively analyze and interpret reality, have to be solidly based on the concepts of knowledge and scientificity.

Numerous research efforts in the domain of surveying made it possible to highlight some differences between traditional and innovative methodologies, identifying timing, control, uncertainty, management and data sharing as the parameters of comparison.

- **Timing**: New technologies and tools for massive data acquisition considerably reduce the time in relation to the quantity of acquired data and to the complexity of the object surveyed. One surveying campaign is often enough for operations which previously would have taken months to perform.
- **Uncertainty**: Digital non contact surveying instruments assure a high level of metric precision with the uncertainty index that can go from a tenth of a millimeter to a centimeter, controlled mainly by a specific objective, or the scale of final restitution and detail level, thus opening up interpretation possibilities more precise in comparison with traditional methodologies.
- **Sharing**: Application of digital technologies and platforms allows for a fast archivization and sharing of acquired information which with the traditional system was reduced to two dimensional representation.

Digital technologies developed for surveying are widely applied in the Architectural-Archaeological Heritage (AAH). Thanks to the continuous technological progress acquisition and elaboration operations are becoming more and more digitalized. This makes for a better integration of heterogeneous data from different systems and makes it possible to obtain better and more complete cognitive results. However, it is necessary that practical-operative actions correspond to the support of the critical and intellectual type which constitutes the basis for a full and knowledgeable development and for initiating further progress.
ORGANIZATION OF THE BOOK

The book is organized into eighteen chapters investigating on surveying and knowledge of Architectural-Archaeological Heritage (AAH). The themes can be identified within three main groups of Cultural Heritage: Teoric Cultural Heritage; Architectural Heritage; Archaeological Heritage. A brief description of each of the chapters follows.

Chapter 1, Representing Architectural Heritage – RAH, describes Architectonical artefacts with the intention of the definition of a protocol designed to achieve an understanding of the object of Cultural Heritage consents the realization of various models. These models are the bases for all the critical, selective, specialist next analyses and elaboration. This work discusses the possibilities offered by the integration of heterogeneous method, traditional and innovative, for massive surveying and digital representation technologies.

Chapter 2, A Reality Integrated BIM for Architectural Heritage Conservation, proposes a method that combines low-cost automatic photogrammetric data acquisition techniques with parametric BIM objects founded on Architectural Treatises and a syntax allowing the transition from the archetype to the type. Point clouds with metric accuracy comparable to that from laser scanning allows accurate as-built model semantically integrated with the ideal model from parametric library. The deviation between as-built model and ideal model is evaluated to determine if feature extraction from point clouds is essential to improve the accuracy of as-built BIM.

Chapter 3, The Importance of Being Honest: Issues of Transparency in Digital Visualization of Architectural Heritage, presents a reflection on the concept of Transparency in digital modeling and visualization of architectural heritage. Moving from topics of transparency and from the experiences in using paradata in different fields to state model’s source, the degree of reliability of virtual reconstructions, and to make the digital model testable by other professionals, transparency and paradata are studied and declined for a dedicated application to historical buildings.

Chapter 4, Definition of a Protocol for the Knowledge, the Analysis, and the Communication of the Architectural Heritage: Single Monument, Network of Monuments, Historic Settlement, analyses the communication of architecture as a complex and multidisciplinary process, indispensable for enhancing a monument properly and to allow understanding and knowledge to a large number of users. The European architectural heritage, and the Italian one in particular, is enormous; the processes of knowledge, cataloguing and analysis are far from being complete. This fact has prompted the European Union to invest, especially in recent years, in research projects designed to increase the communication strategies and put a value on the present assets in its territory. The main goal is to develop a better awareness of the architectural heritage through increased interaction between the citizen, the monument and the scientific community.

Chapter 5, Contribution to the Technical Interpretation of the Roman Sacred Architecture by the New Survey Methods: Case Study – The Nameless Temple of Tipasa (Algeria), analyses the Tipasa’s nameless temple that allows the evaluation of the rational and pertinent use of new means of surveying and representation requiring an architectural knowledge of the subject that helps orient the choice and combination of acquisition methods. The result allows, firstly, for the design of a georeferenced, stone-by-stone survey of the relics at a scale sizable enough to grasp the general large-scale conception by recognizing and identifying the main elements which constitute the temple. Then the use of photogrammetry allowed the elaboration of a significant 2D and 3D database of the architectural elements.
necessary to identify of the type and order of the construction, and will contribute to the researches carried in North African places of worship.

Chapter 6, *Emerging Technologies for the Seismic Assessment of Historical Churches: The Case of the Bell Tower of the Cathedral of Matera, Southern Italy*, analyses low cost and non-destructive survey and investigation procedures are necessary for the seismic assessment. Accurate and fast geometric models can be obtained through digital photo-modeling, and they are the base for finite element models. These models can be updated through ambient vibration testing, which delivers a robust estimate of the fundamental period of the building especially in the case of cantilever-like bell towers. Elastic modulus and boundary conditions can be evaluated through numerical and physical comparison, provided that in situ sampling suggests a masonry density value. Then, compressive strength can be estimated, yielding a more robust seismic assessment.

Chapter 7, *Palazzo dei Tribunali in Via Giulia: Traces of Bramante’s Great Work between Design, Survey, and Analysis*, presents the very first results of research carried out on the Palazzo dei Tribunali in Via Giulia, designed by Bramante but realised only in part. The only fragments that have survived are a few portions of a massive ashlar masonry structure, which characterized the base of the palace. The objective of the research was to carry out an analysis of the site but one that would combine the documentary biblio-iconographic aspect of the study - which would take full account of existing and published articles – with an enquiry based on a direct approach to the site within the metric and perspective-visual frame of reference.

Chapter 8, *Using Laser Scanners to Digitally Survey the Sarnicli Han in Istanbul and the Byzantine Cistern beneath Its Courtyard*, discusses on measurement methods including traditional measurement methods, topographic and photogrammetric measurement methods, measurements via laser scanning devices and aerial photogrammetric measurement. Inclusion process of a Byzantine cistern in Istanbul, Turkey, which was undiscovered for centuries, in our cultural heritage as well as surveying stages of the cistern along with the inn structure built over, using 3D scanning technology shall be described within this study.

Chapter 9, *Scanning Ancient Maya Buildings in the Forest*, presents the study with regards to surveying, terrestrial laser scanning and digital photogrammetry, they are a viable alternative to traditional methods for measuring. Nevertheless, these technologies are rarely used in projects in the Maya region, even though they offer a wide range of applications, which could be explored and utilised in this subtropical environment. This paper presents the results of digital surveying involving two Maya archaeological sites in Guatemala: La Blanca and Chilonché, as well as demonstrating their effective application for “investigating into the past”.

Chapter 10, *3D Digital Models for Scientific Purposes: Between Archaeological Heritage and Reverse Modeling*, discusses on reality-based digital models assist in the achievement of accurate analysis of historical buildings as well as archaeological sites and, more in general, of monuments featuring more or less complex forms. The Octagonal Hall of Small Baths at Hadrian’s Villa, with its daring design of vaults and audacious building techniques, was chosen to test several interpretation techniques based on the customization of contemporary reverse modelling procedures integrated with standard protocols of design analysis and archaeological investigation.

Chapter 11, *Integrated Techniques of Surveying for Morphological Analysis: The Case Study of San Pietro Decca*, discusses on San Pietro di Deca that represent an opportunity for scientific knowledge process experimentation applied to a small building with a great past, an unknown monument standing in north west of Sicily that recently has been studied by a team of Austrian archeologists. The first
scientific survey carried out by the authors by means of the latest technology as well as all the stages of the research are presented: the historical research, the laser scanner survey, the critical analysis leading to the interpretation of the architecture’s masonry structures, and an accurate analytical representation of the transformation processes experienced by the structure from its origin until today. The evaluation of the survey and its comparison with similar Byzantine Sicilian buildings were major steps confirming the hypotheses inferred on the morphological evolution of the structure.

Chapter 12, Drawing, Information, and Design: Tools and Perspective for Conservation, highlights a possible methodological approach to devise an ICT instrument that could support activities for cultural heritage conservation, while maintaining full respect for the specifics of the discipline. Reviewing current ICT and Architecture Engineering and Construction (AEC) applications, it is possible to note that the proposed approach is at the moment reversed: modelling does not arise as the projection of a future object, but rather from the knowledge needed to represent an existing site as accurately as possible. The proposed goal, reflecting the operative methodology of the conservation process, seems to offer a greater range of representativeness and to resolve, at least, some of the critical topics that have arisen from the application of ICT to cultural heritage to date.

Chapter 13, Euryalos Castle and Dionysian Walls in Syracuse: Creation of a Multimedia Tour, presents the history of Euryalos Castle and its multimedia project concept. Thanks to the project, this monument lives through images, allowing visitors to grasp the real evolution of the archaeological landscape and its history. Primary objective of the project was to explain a monument such complex as Euryalos Castle according to modern digital storytelling.

Chapter 14, Between Faith and Reason: New Light on St. Ivo alla Sapienza – Reflections on a Generative Hypothesis, is about the church of S. Ivo alla Sapienza. About the masterpiece of Borromini, it has been said: it was stressed above all its oddness, eccentricity, which critics have always led back to the essence of the Baroque, without examining the possible links that bind their characteristic elements of this building. So, proceeding abduction and venturing to approach sources also apparently alien to each other, it is possible to formulate a thesis: Sant’Ivo is a poem in stone dedicated to Wisdom. Borromini may have scope to create a consideration of Dante’s Divine Comedy, and specifically the third poem dedicated to Paradise and to meet God; and at the same time to draw up a formal summary of the binomial reason / faith, so long discussed the dawn of Christianity.

Chapter 15, Residential Architecture of the Russian Imperial Age (1703-1843) in the Drawings of Italian Architects, describes the research on the residential architecture of the heyday of the Russian Empire that has undergone many changes under the influence of time and urban transformation. However, the drawings of Italian architects as primary sources, can tell a lot about architectural and landscape heritage of the Russian cities of XVIII-XIX centuries. That was the period of origination and development of architectural drawing and Building Code in Russia.

Chapter 16, Low Cost Hand Held 3D Scanning for Cultural Heritage: State of the Art and Perspective, aims to survey the most recent 3D handheld scanners and studies the possibility to employ the handheld scanners in the field of Cultural Heritage is conducted. In this investigation, a doorway of the Benedictine Monastery of Catania, has been used as study case for a comparison between stationary Time of Flight scanner, photogrammetry-based 3D reconstruction and handheld scanning. The study is completed by an evaluation of the meshes quality obtained with the three different kinds of technology and a 3D modeling reproduction of the case-study doorway.

Chapter 17, A Second Look for a New Cycle of Life: From Main Post Office to Bicentennial Cultural Center – Survey and Registry for the Restoration, illustrates the case of the former headquarters of the
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Buenos Aires Main Post Office, the development of new means of communication made the traditional postal traffic volume decrease, resulting in an oversized building according to present circumstances. In this context, the need was inevitable – and cultural and technical possibility – to give another meaning to the building, starting a new cycle of social use from a program compatible with its urban and architectural features. The present work refers to the graphic documents of the old substance of the building, focusing on the existing element on which the intervention was planned, with the objective of studying the components on which the conservation, restoration and intervention would develop.

Chapter 18, *A Cross Reading of Landscape*, illustrates the results of a research project entitled “Landscape Information: new tools and methodologies for the representation of the landscape.” The case study selected for this research on the many aspects of the landscape is the vast territory included in the municipalities facing the Lake Garda, a significant example of “territory-landscape”, where different environmental characteristics meet, and through dynamic processes of interaction and transformation were generated specific natural and social forms.

Chapter 19, “*Discretizzazione*” and *Data Analysis at the Time of “Total Survey.”* contains considerations and methods of analysis of data acquired using modern surveying technologies, applied to cultural heritage. Three case studies are carried out. They are different in type of monuments, aim of survey and survey techniques used. The large amount of data acquired through innovative techniques of photographic survey and laser scanning requires an adequate process of “discretizzazione”. It will change an uncritical “total survey” into a selective and effective analysis and communication process. An excess of information could distract from the actual purpose of survey, and it could provide the illusion of a comprehensive understanding of the monument. Actually, the real knowledge does not come from the amount of data acquired but from the ability to analyze them, to relate and communicate to potential users.

Although partial, these works have clearly enlightened the possibility (and maybe the need) of establishing general operative guidelines for archaeological surveying in order to unify and regulate the procedures of data collection, elaboration and representation that will make the final result scientific in character, i.e. more objective and correct.

The comparison with other experiences in this field, the test of different methodologies on different scale objects will lead to the establishment of flexible modus operandi, which lends itself to adaptation in specific, concrete cases or to the needs of surveying maintaining, at the same time, the versatile character of the survey.

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REFERENCES


