La documentazione del patrimonio culturale: un punto di partenza corretto per pianificare azioni di valorizzazione e conservazione

The documentation of cultural heritage: the right starting point to plan optimisation and conservation actions

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La Documentazione del Patrimonio Culturale viene oggi definita come la raccolta ragionata e sintetica delle informazioni utili per una corretta progettazione di un qualsiasi intervento su un Bene Culturale: conoscenza, valorizzazione, conservazione, gestione, restauro.
Oggi tutte le informazioni relative ad un determinato Bene Culturale possono essere memorizzate digitalmente agevolando la georeferenziazione delle stesse all'interno di modelli 3D (o 2D).
La georeferenziazione di tali informazioni consente di comprendere le mutue relazioni tra i diversi fenomeni analizzati e offrono agli specialisti chiavi di interpretazione complete e di qualità certificata come base per l'elaborazione di un qualsivoglia progetto di intervento.

Cultural Heritage Documentation is now defined as the reasoned and synthetic collection of valuable information for correctly planning any intervention on a Cultural Asset: knowledge, enhancement, conservation, management and restoration.
Today, all the information relating to a specific Cultural Asset can be stored digitally, facilitating georeferencing within 3D (or 2D) models.
The georeferencing of such information allows us to understand the mutual relationships between the different analysed phenomena and offers specialists complete and quality-certified interpretation keys for developing any intervention project.

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1. Documentation of Cultural Heritage

Architectural and naturalistic Cultural Heritage are studied for different purposes: knowledge of their origin, evolution over time, management, enhancement, conservation, change of intended use and restoration interventions. Each intervention always requires a set of helpful information to satisfy the specific needs of the intervention to be carried out.

As also happened in the past and unfortunately continues today, the information necessary for a specific intervention is not shared effectively, so often, designers are forced to repeat investigations already carried out because they cannot access already known and still valid data.

At international level, ICOMOS (International Committee Of Monuments and Sites) has felt the need to deal directly with the issue of "Documentation", proposing this approach to all specialists who work, in any capacity, on Cultural Heritage.

In the past, the first approach to knowledge of a built Cultural Heritage was limited to a metric survey. The development of surveying techniques over the centuries meant that, in the mid-19th century, Photogrammetry was considered the most suitable technique for the metric survey of built Cultural Heritage.

For this reason, in 1968, ICOMOS and ISPRS (International Society of Photogrammetry and Remote Sensing) founded the CIPA (Comité International de Photogrammétrie Architecturale). This International Scientific Committee aimed to develop studies on how Photogrammetry should be used to provide designers with the metric information needed to plan conservation and restoration interventions.

The metric survey was then integrated with other types of measurement capable of highlighting the factors that would influence the intervention project on the property. However, these two types of informa tion were separate as they were usually stored on paper documents (drawings, reports, etc.).

Starting from the 1980s, the development of digital technologies has made it possible to improve the performance of metric survey techniques, thanks also to the introduction of new tools that have led to a real revolution in metric surveying: scanning systems based on laser or structured light technology, metric processing of digital images to reach the present day, in which systems for the real-time acquisition of point clouds based on SLAM (Simultaneous Location And Mapping) technology are becoming established on the market.

This development has led to a radical change in metric surveying: from the acquisition of a few significant points chosen by the surveyor for the reconstruction of two- and three-dimensional geometries, we have moved on to the acquisition of very dense point clouds from which three-dimensional models of varying accuracy and detail can be generated, chosen according to the purposes that the metric survey must achieve.

At the same time, all the information related to the knowledge of physical-chemical phenomena that allow us to record the state of material and structural degradation of a building, as well as that deducible from historical archives (documents, photographs, paintings, videos, etc.) that allow us to understand its genesis and transformations over time, has been transformed into digital information and is therefore fully integrable into two-dimensional and three-dimensional models as needed.

For these reasons, ICOMOS has expanded the mission of the CIPA, renamed CIPA-Heritage Documentation, inviting this committee to develop research and significant examples of documentation of Cultural Heritage.
The term "Documentation" now refers to the collection of data of various types, not only metrics, detected and collected before any intervention, recommending their sharing with tools that allow easy access to the results of the analyses carried out for a specific purpose.
The Documentation, for reasons related to the variation of data over time and for the breadth and diversity of information that can be useful in the design of the various interventions, is by its very nature a product of continuous evolution and updating. Consequently "documentation" is not a static but a dynamic product, and to guarantee its updating and integration, it is necessary to adopt appropriate measures to ensure the sharing of what is achieved from time to time.

2. Data Sharing

The need to share data collected and/or measured for a specific purpose involves adopting a correct definition of the information associated with each piece of data to make it correctly interpretable (comprehensible data). Another critical factor is the choice of digital storage and distribution formats to share the data with the community of interest represented by scholars and professionals called upon to design interventions on the asset (accessible data).
In both cases, we are oriented towards solutions known in the IT field, adapting them to the peculiarities of cultural assets to facilitate the necessary integration of valuable technical and humanistic information for the formation of documentation of Cultural Heritage. This approach should be consistent with the indications provided at international level by the international scientific committee CIPA-Heritage documentation to ensure that the entire community of restorers and conservators who refer to the directives approved by ICOMOS can effectively access the data already known and certified.

2.1 Comprehensible data

For data to be correctly comprehensible, it is necessary to accompany it with a set of information called "metadata" and "paradata".
"Metadata" are represented by that information necessary to understand the nature of the data itself. Examples of metadata are the purpose for which the data was recorded, the possible unit of measurement used, the origin of the data, and the possible instrument and methodology used.
Paradata are the information necessary to fully understand the process that generated the primitive data: the acquisition period, the strategies used for the collection, and the operator who provided the data.
Correct metadata and paradata allow us to associate a "quality" parameter to each piece of data. The specialist who intends to use correctly described data, analysing the consistency of the data and its quality, can judge if and how much that type of data is helpful for the purpose of the specialist.
Consider the simple example of metric data, such as the point cloud of a building. The "data" is represented by the point cloud, i.e. a list of points with their respective X, Y and Z coordinates.

The metadata says that the unit of measurement is the meter, that the precision is ± 0.02 m and that the accuracy is ± 0.03 m, that the measurement was performed in the context of a metric survey of a particular urban context, that the point cloud was generated with automatic digital photogrammetry using the CANON EOS R7 camera with CANON RF 35 mm lens for image acquisition, the METASHAPE platform for generating the point cloud itself, and the purpose for which the survey was performed (e.g. facade conservation project).
The paradata tell us that the images were acquired on a specific date, by a person (identified by Name and Surname and contact method) and that the processing for generating the point cloud was performed by an operator identified with the same methods.
The data, accompanied by its metadata and paradata, finally becomes accurate "information" and can, therefore, be shared, avoiding erroneous interpretations and incorrect uses.

2.2 Accessible data

The accessibility of data can be guaranteed by using internationally accepted digital formats accessible from the most popular software platforms. For example, for text documents, the "pdf" format; for images, the "JPEG" or "TIFF" formats; for numerical data, formats such as "xls", "txt" and similar; for videos "mp4" format.
In the context of the Documentation of Cultural Heritage, as previously defined, this type of accessibility is not sufficient.
The data needed for documentation are collected and analysed by specialists who are responsible for designing a Cultural Heritage intervention, who are not interested in the actual data but, above all, in the results of the analyses performed considering the data acquired to describe the nature and evolution of the phenomena that characterize the life of the object.
Localizing different types of data in a defined spatial context has proven to be the best strategy for understanding the mutual correlations between phenomena, even of different natures, that manifest themselves on a property, influencing its evolution over time.
Scientific research and applications developed over the last 50 years have shown that the best technologies for managing digital data within defined spatial contexts are represented by GIS (Geographic Information Systems) and HBIM (Historic Building Information Modelling).
These two technologies are based on the same concept: associating a geometric space with a relational database to highlight the correlations between the data and their position within the space used. The different types of data are stored on different levels that connect via the spatial position associated with each piece of information. In this way, it is possible to carry out analyses using different types of data (stored on different levels) that can provide an interpretation of a specific phenomenon (Figure 1)[1].
While GIS (Geographic Information Systems) platforms are better suited to managing data located in a two-dimensional space, HBIM (Historical Building Information Modelling) platforms are the most suitable solution today for managing databases in a three-dimensional space.
Here we present two simple examples of the use of GIS and HBIM for collecting information useful for specific knowledge and conservation projects carried out in the context of two master's theses at the School of Architecture of the Politecnico di Torino.

1 Robin Letellier, *Recording, documentation and information management for conserving heritage places*, The Getty Conservation Institute, Los Angeles 2007; https://www.getty.edu/conservation/publications_resources/pdf_publications/recordim.html.

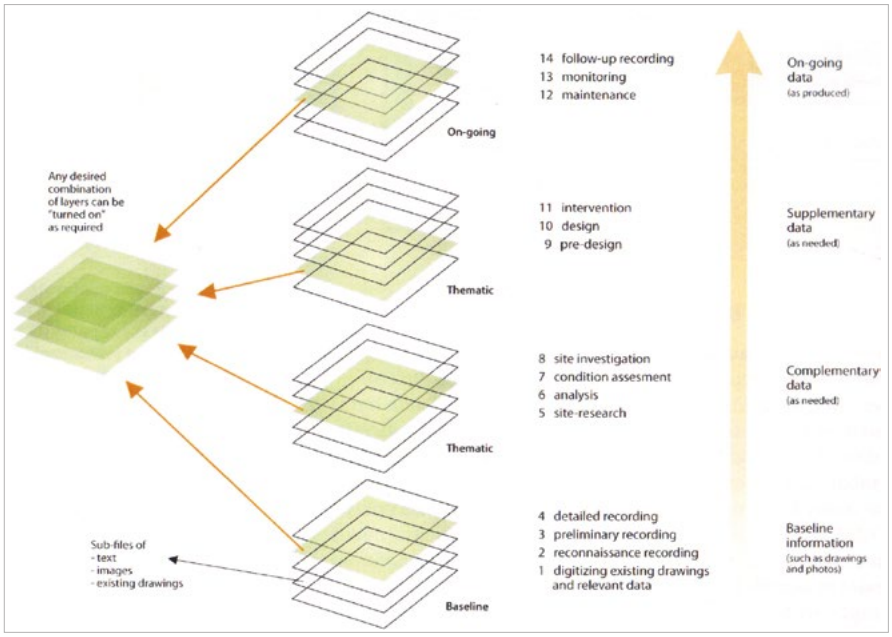


Fig. 1 – Example of a database structure for GIS and HBIM. Image from: Robin Letellier, *Recording, documentation and information management for the conservation of heritage places*, The Getty Conservation Institute, Los Angeles 2007. The full text from which this figure is extracted is available for free download at the address provided in footnote 1.

3. Data management on the GIS platform

The thesis entitled "Reviving A Cinema Memory. The Restoration and Adaptive Reuse of Lakshmi Building" (supervisors prof. S. Gron, F. Rinaudo, M. Mattone, C. Tosco)[2] aims to restore an abandoned building in the city of Lahore in Pakistan its original use as a movie theatre. The building that is the subject of the project is located in a neighbourhood of the city without any movie theatres. By contrast, the neighbourhood was considered the cultural centre of Pakistani cinematography years ago.

To demonstrate this, an investigation was conducted in the city archives to recover data that could support the project idea. For all the buildings in the neighbourhood, data dating back to the 19th century were recovered from the city archives, along with the same data as they appear today: the year of construction of the building, the type of ownership (public or private), the type of prevalent use, the presence of recreational activities, the state of degradation of the buildings, abandoned buildings, volumetric consistencies, etc.

The data, entered into a layer in a GIS environment, allowed us to use thematic maps to synthetically visualize the urban apparatus's transformation phenomena and was used later to decide the type of intervention to design.

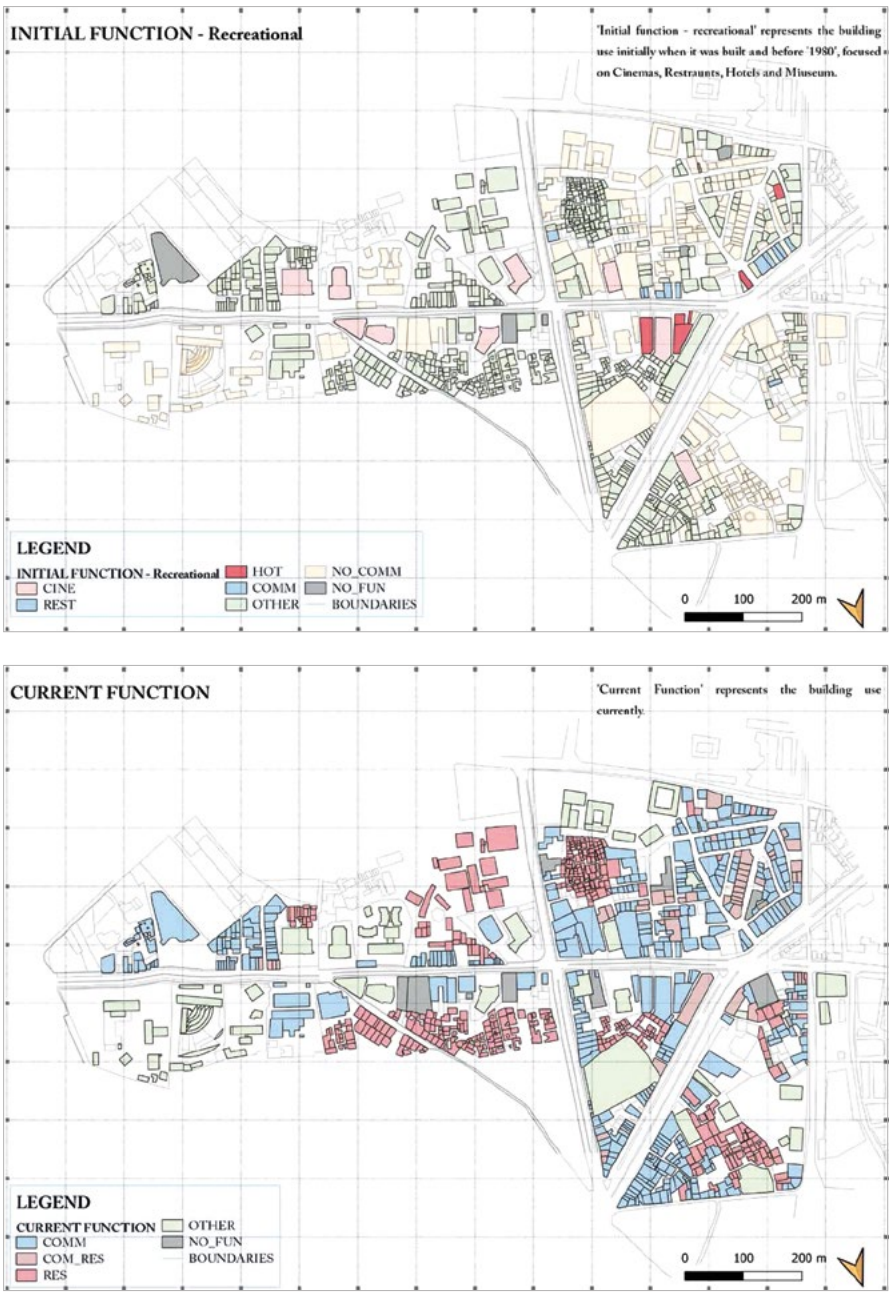
Figures 2 and 3 show the change of use of the buildings in the neighbourhood in 1980 and today, demonstrating how the idea of proceeding with an intervention to repurpose the abandoned building is based on a desire to evoke a cultural phenomenon that is no longer perceptible by the inhabitants.

4. Data management on the HBIM platform

The thesis entitled "Valentino Castle North Wing: A Study of a Documentation-Oriented HBIM Framework" (supervisors prof. L. Teppati Losé, F. Rinaudo)[3] aims to build documentation for future restoration work on the North Wing of Valentino Castle.

Using HBIM technology to store and use documentation data requires the creation of a 3D model with a level of detail suitable for

2 https://webthesis.biblio.polito.it/14218/.
3 https://webthesis.biblio.polito.it/31674/.



Figg. 2, 3 – Use of the buildings before 1980 and Use of the buildings in 2023. Images from: Rai Karam Elahi, *Reviving a cinematic memory The Restoration and Adaptive reuse of Lakshmi Building*, thesis, Politecnico di Torino, 2020. The full text from which these figures are extracted is available for free download at the address provided in footnote 2.

accommodating all the information, starting from the point clouds generated with current metric survey techniques.
Each structure detail that must accommodate information is represented as a single 3D object, the position of which is defined within the entire space analysed.
Once the 3D models of the elementary entities have been generated, the non-metric information are stored in the database, ready to be queried according to the designer's needs.
Figure 4 shows the transition from the point cloud to the modelling of the documentation objects.

5. Final considerations

All the specialists who work on Cultural Heritage in various capacities are the authors of the Documentation: the different skills required (metric survey, measurement of physical-chemical properties, extraction of information from historical archives, degradation analysis, stratigraphic analysis, etc.) require the designer to coordinate a team

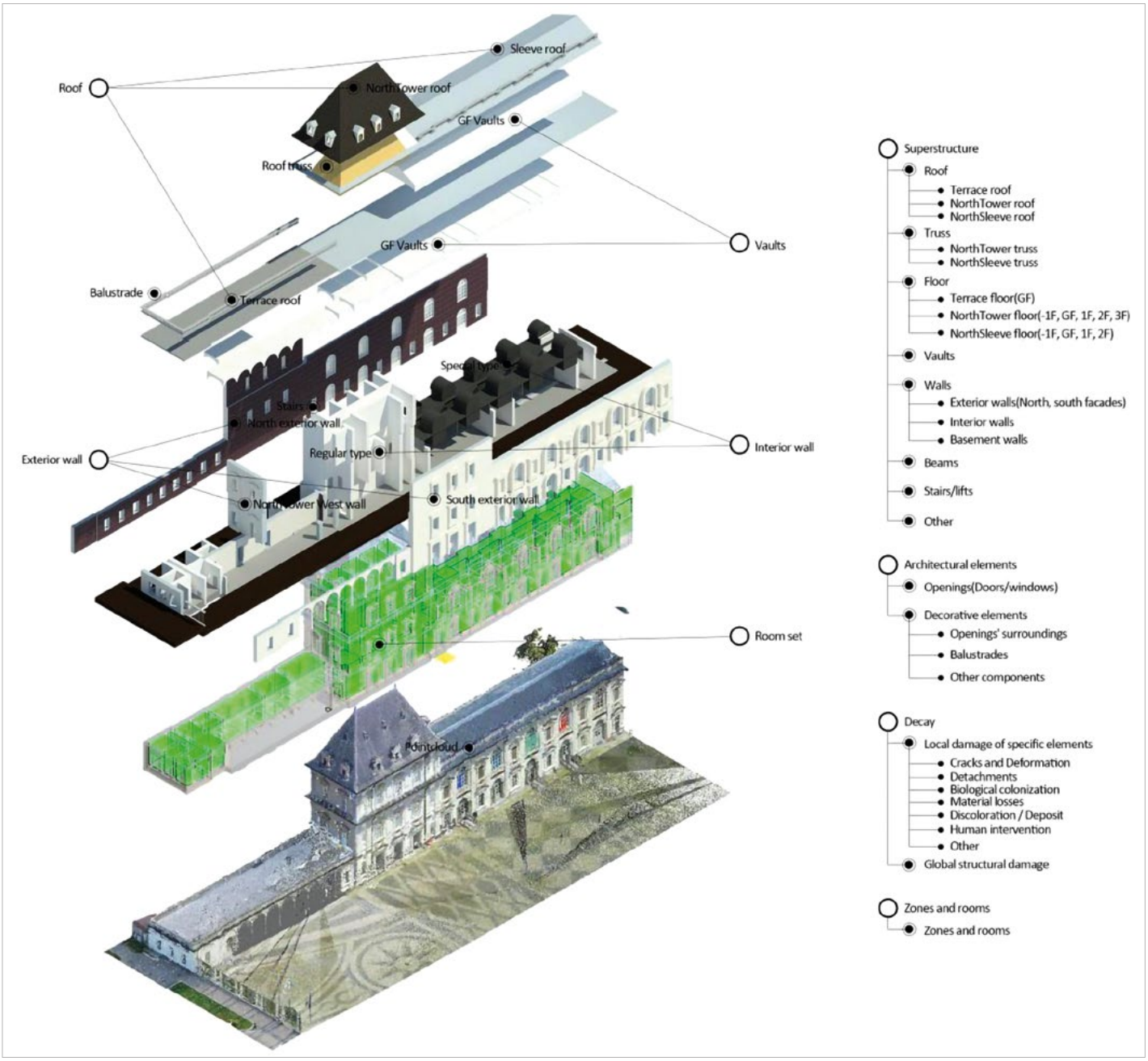


Fig. 4 – Exploded-view diagram of different types of architectural elements' geometric modelling in HBIM. Image from: Xiang Li, *Valentino Castle North Wing: A Study of a Documentation-Oriented HBIM Framework*, thesis, Politecnico di Torino, Torino 2024. The full text from which this figure is extracted is available for free download at the address provided in footnote 3.

of experts in the different disciplines. The designer asks these experts specific questions on the type of information he needs to be able to carry out the requested intervention. It is the task of the various specialists to find the best solution in terms of tools to use and techniques to adopt, taking into account the rapid technological evolution that expands the number of possible solutions, as well as the need to achieve the necessary quality of information and the right economic balance.