

# Filling the gap. The challenge of loss and two outcomes of the *Mapping Sacred Spaces* Project

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## Abstract

*The Mapping Sacred Spaces Project addresses the reconstruction of medieval sacred architecture in Southern Italy, with a particular focus on the critical loss of liturgical furnishings and their contextual significance. Through the transformative power of digital humanities, this project embraces interdisciplinary approaches to effectively fill the gaps left by historical damage and the passage of time. Employing advanced digital methodologies, the project meticulously recreates and analyzes the interactions between space, objects, and ritual practices, thereby dramatically enhancing our understanding of the region's rich artistic and cultural heritage. Significantly, hermeneutic and heuristic issues arise in creating digital models that aim to fill in gaps. Two case studies pertaining the Monreale Cathedral and the abbey church of Montecassino exhibit both the potential and the limits of digital approaches.*

## Keywords and CCS Concepts

• Sacred Spaces; Monreale Cathedral; Montecassino abbey church; Digital Modelling and 3D Modelling → Transparency and Uncertainty

## 1. Introduction

Thanks to Digital Humanities, challenges that until a few years ago seemed to be the prerogative of archaeological disciplines have now fully entered the field of art history. Besides the need to manage an ever-increasing amount of data – no longer coming solely from historical-artistic disciplines but also from other humanistic and scientific disciplines – the imperative to confront losses makes the use of Digital Humanities inevitable, i.e.: the need to fill the gaps caused by time and human-induced damages to the works and spaces of the past. These gaps prevent us from reading objects, works, and monuments in their entirety, increasing our epistemological and hermeneutical challenges. Only the reconstruction of space in its time allows us to fully grasp the relationships between artworks and their functions in context. Thus, the virtual rendering of space that no longer exists and objects that have disappeared has become a fundamental methodological practice in Art History studies, for which Digital Humanities are an irreplaceable tool. (Further considerations on these aspects are in Lon23; LS25a).

## 2. Research questions: the challenges of loss in the case of medieval sacred spaces

Historical research on medieval sacred architecture requires reconstructive investigations, as many liturgical areas, their furnishings, and their decorations have been lost. Moreover, the preliminary reconstruction enables us to investigate the perceptual dimension of the sacred in its original historical setting.

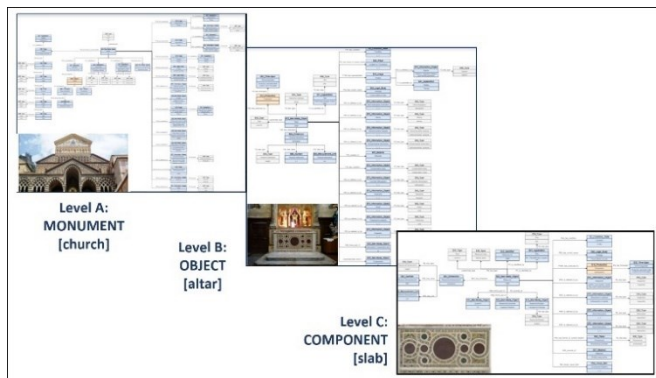
The remarkable role liturgical furnishings such as altars, ambos, ciboria, and enclosures had and still have should not be underestimated. However, medieval architecture is quite difficult to see in its original state after so many transformations and restorations, and a very high percentage of Italian medieval liturgical furnishings are now lost or decontextualized. For a variety of reasons, including the Catholic Church's reforms throughout the Italian Peninsula and the functional and aesthetic demands of the Renaissance and Baroque periods, most medieval furnishings have not survived or have been dismantled and rendered fragmentary. In many cases, these decontextualized elements have been recombined in other ensembles or repurposed [GS18] [LS22].

## 3. The *Mapping Sacred Spaces* Project

Compared to other regions, Southern Italy is still little investigated from the point of view of the reconstruction of sacred spaces and liturgical contexts. Additionally, only in recent years has scholarship started applying methodologies that take into account the interactions between space, objects, images, and ritual performance. The potential offered today by the integration of archaeology and art history with digital technologies is particularly significant for this kind of reconstruction and analysis. The project *Mapping Sacred Spaces. Forms, Functions and Aesthetics in Medieval Southern Italy* (based at Bibliotheca Hertziana – Max Planck Institute for Art History, in collaboration with Sapienza Università di Roma and Università di Siena) has thus been designed with the aim of analyzing the scattered evidence pertaining to eleventh- through fourteenth-century liturgical installations and to reconstruct monumental furnishings, such as enclosures, altars, and ciboria. The project promotes an approach based on established methodologies in Art History and Archaeology, in a dialogue with liturgical studies and scientific investigations on materials and techniques employed in medieval furnishings [Lon11] [GL20] [LS22]. It also exploits the potential offered by Digital Humanities [LS21] [GLS25].

The project first built a census of monuments and sites documenting the locations and material traces of medieval liturgical furnishings held in Southern Italy (currently counts 338 records). Due to the diachronic changes in the locations and functions of many furnishings, spatializing the research data is a fundamental need. An interactive digital map displays the data collected by the project's research team and can be queried from the macroscale (monuments) down to the microscale (objects and their components). This is the basis for a research corpus dedicated to liturgical furnishings produced in Southern Italy between the eleventh and fourteenth centuries. The database connected to this interactive map is the project's digital archive. It is organized on different scales corresponding to three hierarchical levels (Fig. 1).

Level A includes monuments, museums, or other sites containing objects and fragments with locations mapped in the building's plan. Level B includes monumental objects, i.e. medieval liturgical installations (pulpits, altars, ciboria, etc.), or post-medieval assemblages including fragments of medieval furnishings. Level C catalogues their components, either *in situ* or as scattered fragments.



**Figure 1:** CIDOC-CRM-based ontologies of the MSS-Digital Archive corresponding to three different scales (monuments, objects, components).

This hierarchy corresponds to forms with different ontologies based on CIDOC-CRM and integrates them with other knowledge graphs for each level. These ontologies respond to the descriptive, historical, and relational matters at the centre of the investigation.

The database, implemented and integrated into the data management system of the Bibliotheca Hertziana-MPI by Alessandro Adamou, provides a series of semantically modelled fields for specific research questions. Besides the usual queries used for cataloguing architectural and art historical entities (author, date, form, style, patronage, etc.), these include, for example, the provenance of objects and fragments, the ornamental patterns employed, the techniques and materials, scientific analyses, restoration and conservation history, relationships among objects and historical actors. Topological relationships are also modelled between the original location and function (when known), which may not coincide with the current ones.

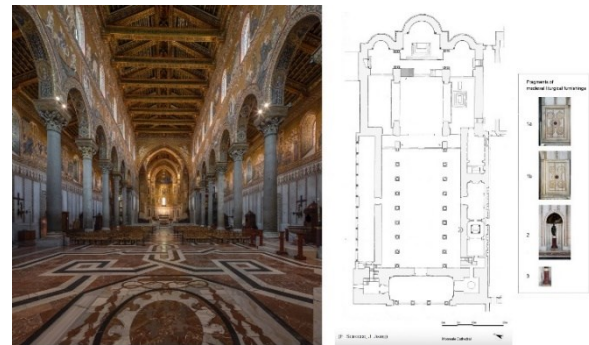
#### 4. Methods, results and open issues. Two case studies: Monreale Cathedral and Montecassino abbey church

Two case studies will illustrate the methods and results of the project, both of which are ongoing research ventures at different stages of completion. The first case, pertaining to Monreale Cathedral, will focus on a well-preserved, late twelfth-century medieval sacred building that lost its original liturgical installations and most of their material evidence. The main challenge here is the effort to propose a digital anastylosis of this lost monumental ensemble. The second case, related to Montecassino's abbey church of the late eleventh century, represents one of the greatest challenges in the field of historical-artistic and archaeological research, namely the attempt to outline an architectural space whose original configuration has left almost no traces, together with the monumental objects and liturgical installations it contained in the Middle Ages. In both cases, beyond the topographical data obtained from surveying the existing architecture (Monreale) or from archaeological post-war surveys (Montecassino), the data available consists of textual sources, archival documents and very few material fragments.

##### 4.1. Lost objects in surviving spaces: Monreale cathedral and digital modelling in a well-preserved context

The cathedral church of Monreale is a three-nave basilica (approximately 102 meters long and 40 metres wide) founded by the Norman King William II (1166-1189) in 1172. [Krö65] [Dit03]. Thanks to its magnificence and the preciousness of its decorations, this is one of the most important religious monuments in the Mediterranean. Best known for its golden wall mosaics (over 6,500 square meters), the building also features less studied but equally important marble pavements and marble inlay wainscoting (*opus sectile*). A key component of the medieval building was the majestic double choir screen with its attached ambo, dismantled piece by piece in 1658 at the behest of Archbishop Ludovico Alfonso de Los

Cameros [discussion and hypothetical reconstructions are in Del02, Gra59, Zor09], whose fragments are today preserved in both the church (Figure 02) and the exhibition spaces of the cathedral complex.

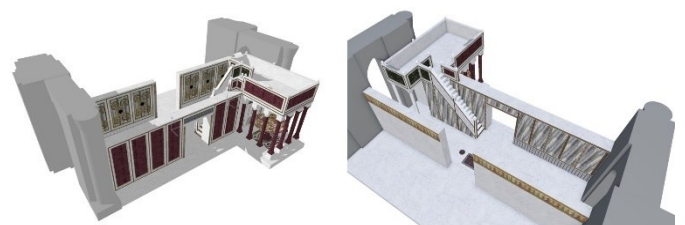


**Figure 2:** left) Monreale (Palermo), Santa Maria La Nuova cathedral, interior view looking East (© Bibliotheca Hertziana – MPI, Roberto Sigismondi); right) Plan of Monreale cathedral (elaboration: E. Scirocco & J. Jiang from Krönig 1965), with mapping and numbering of the extant remaining components and fragments of the medieval liturgical installation.

Counterbalancing this void is a considerable amount of data, mostly consisting of textual and graphic sources, including a very detailed inventory compiled during the dismantling process of the choir screens and the ambo in 1658 [Gra59] [LS25a] [LS25b]. Other sources include a map of the Monreale complex featuring a reliable plan of the church (with its medieval liturgical installations still *in situ*) attached to the 1590 *relatio ad limina*, held in the Vatican Apostolic Archive (AAV, Congr. Concilio, Relat. Dioec., 574A) and early modern textual descriptions [listed and discussed in LS25b].

Material evidence as well as information mined from textual and graphic sources have entered the *Mapping Sacred Spaces* database. Investigations carried out on the *opus sectile* floor and wall coverings in the church made it possible to identify of the original floor elevations and the precise topographical areas occupied by the monumental twelfth-century furnishings [LS25a] [LS25b].

The first attempt to virtually reconstruct the sumptuous liturgical installation was initiated in 2009 and refined in 2018 with a 3D rendering [Sci10] [Sci16] [LS20]. The need for a reliable, documented, editable, and verifiable model generated the need a more complex methodology. A new reconstruction (or virtual anastylosis) was made by 3D digital modelling with HBIM technology, performed in collaboration with Piotr Kuroczyński and Karol Argasiński (Hochschule Mainz, Warsaw University of Technology). The model thus serves as a repository for research data organized not in tabular form but in a topographical and three-dimensional form (Fig. 3).



**Figure 3:** HBIM of the medieval choir screen with the attached ambo in the cathedral of Monreale, reconstruction hypothesis by R. Longo and E. Scirocco 2023. 6a (left): view from NW; 6b (right): view from NE. ©Ruggero Longo and Elisabetta Scirocco, Bibliotheca Hertziana – Max Planck Institute for Art History (HBIM design: Karol Argasiński).

The texture adopted is based on the surviving fragments and the original wainscotings. Thanks to the model, we could deduce the dimensions (e.g. height of the Western choir screen, 4.2 m, and of the ambo, 5.5 m). Overall, the margin of error in the model's measurements is relatively low, estimated between 5 and 8 cm, approximated from those in the 1658 inventory [LS2025a].

The model's metadata include functions, dimensions, and constituent

materials of the elements represented in the model (with reference to the [AAT®](#)). Components modelled on real extant objects specify their current location and conservation conditions. Paradata include material, textual, or graphic sources used to create the modelling, position, and texture of each component. A three-part scale of uncertainty explains the degree of reliability of the representation: low, medium, and high, with related definitions. The aim was here to visually reconstruct the precise locations of the different components of the choir screens and the ambo of Monreale, adhering as much as possible to the historical and archaeological data available. The result allows for a substantial re-evaluation of previous interpretations in scholarship. The HBIM model can be refined with new data, and every choice can be edited or changed. The model is not the research's final goal, but a powerful heuristic tool for future implementations [CMS23] [Caz25]. The goal for the next few months is to incorporate all related metadata and paradata into the model and publish it, making it available according to the [FAIR principles](#). Much effort has been made to formulate common paths (for example, the [London Charter for the computer visualization of cultural heritage](#) or the 2011 [Sevilla Principles of virtual archaeology](#)). However, the scientific community has not yet reached unanimity—either among the different disciplines involved in 3D modeling or within Art History itself—regarding standards for reconstructive models. Areas under debate, among others, include shared open-access infrastructures for publishing and annotating three-dimensional reconstruction models, the assessment of the scale of uncertainty, and standards for the publication of three-dimensional research-based models as scientific products. We therefore chose our first group of annotations for the HBIM model according to the needs of our case study [LS25a].

#### 4.2. The challenge of the lost: Montecassino abbey church and ongoing practices to reconstruct lost sites and objects

The modern transformation (early 18<sup>th</sup> c.) and later war destruction (1944) of the abbey church of Montecassino built and decorated 1066-1071 under the patronage of abbot Desiderius exemplifies one of the greatest losses in the history of medieval monuments. A large number of historical sources and abundant critical literature testifies to the importance of the monument. Various sources describe its renovation, such as the description by Leo Ostiense in the *Chronica monasterii Casinensis* (in particular III, 26-33) and in the *Narratio de consecratione ecclesiae Casinensis* (Hof80) [AL01].

While Desiderio's church and its liturgical furnishings are irreparably lost, the memories of the medieval building are important and authoritative, not least for the architectural and art historical impact that it had in the central Middle Ages in Southern Italy and beyond. For the same reasons, the challenge of attempting a 3D digital restoration of the Desiderian church and its liturgical furnishings at the time of its new consecration (1071) has been undertaken within the PRIN project *MeMemory of Montecassino - Virtual and Accessible Museum*, coordinated by Università di Cassino e del Lazio Meridionale with Sapienza Università di Roma, in collaboration with the Bibliotheca Hertziana and the University of Siena. The authors of this article are conducting research and supervising the 3D modelling of Montecassino abbey church described by Leo Marsicanus. The aim is to render the building, the *opus sectile* marble floor, and the liturgical furnishings dating to circa 1071 (the modelling is carried out by the @Archeo&Arte3D laboratory of DigiLab, Sapienza University). Although myriad textual sources are available, they lack detailed descriptions of individual furnishings, except for cursory remarks and measurements in Roman cubits. Relevant topographical information comes from: a survey carried out in the early 16<sup>th</sup> century by Antonio and Giovanni Battista da Sangallo (Firenze, GDSU 181A, 182Ar), fairly accurate but done after reconstruction work that followed a devastating earthquake in 1349; a plan with the medieval marble floor executed in 1713, before the installation of a new floor [Gat33, Pl. VI]; an archaeological survey carried out after the

bombings and before the reconstruction in the 1950s [Pan73].

Leo Ostiense describes the basilica church and its dimensions. He mentions three naves with three apses, a raised transept, two rows of ten columns each in the nave, the marble enclosure of the monks' choir (white marble, red and green porphyry), with a wooden epistyle supported by six columns and enriched with thirteen byzantine icons. He also mentions a bronze beam supporting fifty candelabra and thirty-six suspended lamps, and another silver beam supported by four silver columns, resting on bronze transennae that separated the choir from the presbytery. The chronicler describes one altar in each apse and the high altar placed above the tomb of St. Benedict, with its ciborium enriched with icons and a gold antependium depicting stories from the Gospel and St. Benedict. Liturgical furnishings included a wooden ambo and a Paschal candelabrum made of silver on a porphyry base. Drawing an image from the written description alone is a delicate operation, requiring simultaneous hermeneutic and heuristic processes. Creating interpretive models from often ambiguous Latin words that refer to lost spaces raises constant questions regarding specific decisions and opens several alternatives. Kenneth J. Conant and Jennifer M. Sheppard have already demonstrated this, offering different interpretations of Leo's description [Gil47, fig. 1] [Blo86, fig. 27] [She82, fig. 3] [DBS23].

In order to obtain a reliable model, we started from the interpolations of the available plans, to verify the surviving topographical data through archaeological evidence and surveys done prior to the transformations and destruction. The elevations were modelled on the most reliable planimetric basis, considering the measurements in the sources and those obtained from archaeological surveys, (Fig. 4).



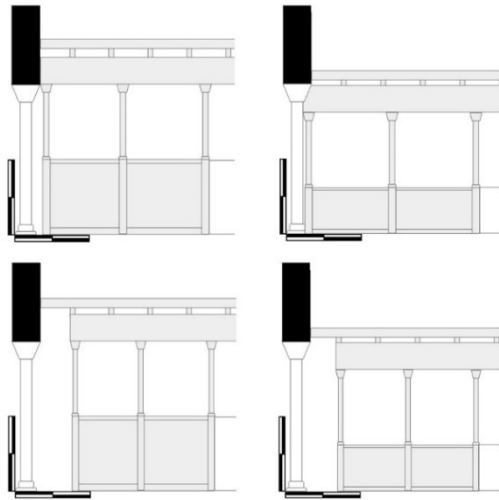
**Figure 4:** Hypothetical rendering of Montecassino abbey church ca. 1071, based on the archaeological survey of the medieval church made after the 1944 bombing and published by Pantoni 1973 (scientific design by Manuela Gianandrea, Ruggero Longo, Elisabetta Sciocco; graphic: Giulia Chellini).

Modelling the objects contained in the structure has proven to be the most complex task. Questions arose about the shape and dimensions of the choir (unrecorded in the source), the shape and height of the choir front (for which we only know the height of the columns), whether it is connected to the walls of the central nave (if so, how and at what height), and finally the ambo's shape, position, and dimensions. Regarding the choir front, modelling offers a new visual interpretation of Leo's description, connecting the wooden epistyle and the bronze beam (already suggested by [Gia06] by means of bronze elements shaped like arms and hands (*brachiis et manibus*)). However, it has not yet been possible to choose between the different solutions for the height and anchoring of the marble enclosure to the columns, and that of the epistyle and the bronze beam to the walls of the nave (Fig. 5). Finally, the greatest challenge will be selecting plausible textures to replace the model's, based on comparative and statistical analyses of similar extant elements in medieval European monuments.

#### 5. Conclusions

The power of digital models lies in their ability to stand in for the original object, conveying even more information to be interpreted and recorded. This allows for scientific approaches and makes workflows

and uncertainties traceable and transparent. Furthermore, modelling and annotating the process responds to hermeneutic and epistemological needs to manage large quantities of available



**Figure 5:** Four hypothetical renderings of Montecassino abbey church choir front screen (scientific design: Manuela Gianandrea, Ruggero Longo, Elisabetta Scirocco; graphics: Ruggero Longo).

but fragmented information. 3D modelling is thus an indispensable heuristic tool, subjecting hypotheses to verification and possible correction. Above all, it dynamically represents the current state of research and can be modified as new data and hypotheses emerge.

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