Digital Modeling and Social Connections for Heritage Management: the Case of the Palazzo del Governatore in Parma

Virginia Droghetti

Abstract

The knowledge and management of architectural heritage can no longer be considered merely technical or conservation-oriented operations. In this perspective, drawing, modeling, and representation become critical acts capable of generating new social connections among subjects, institutions, architectures, and data. This contribution explores this perspective through the case study of the palazzo del Governatore in Parma, where the construction of the digital model –from survey activities to information management, including cloud-based and immersive environment experimentation– is configured as a process of knowledge co-production rather than mere digitization. Parametric modeling, BIM, and collaborative platforms were used to integrate management, maintenance, and exhibition-related needs within a shared information environment. The model supports different forms of consultation and building management by the actors involved, enabling more inclusive approaches to management, maintenance, and design. Through this approach, representation goes beyond its descriptive function and emerges as a space in which knowledge, the role of the architect, and forms of participation in the construction of contemporary cultural heritage are ethically redefined.

Keywords: social connections, digital modeling, BIM, existing built heritage, palazzo del Governatore.

Introduction

In the contemporary debate on built heritage management, attention is progressively shifting from the idea of the building as a static entity toward the awareness that every architecture exists within a social and informational ecosystem [Mazzetto 2024]. Built heritage can be interpreted as a relational system, defined by the interactions between actors, management practices, and representation tools. Survey technologies, BIM, and parametric modeling directly influence the management, consultation, and updating of heritage information [Bianchini, Inglese, Ippolito 2016; Sacks et al. 2018].
From this perspective, knowledge of built heritage depends on the interaction between management practices, decision-making processes, and representation tools.

The value of historical heritage is also defined in relation to community needs, conservation policies, and the digital tools adopted for its management [Deng, Menassa, Kamat 2021]. Digital representation involves interpretative, organizational, and managerial choices. It therefore becomes a space of critical mediation in which maintenance needs, functional uses, cultural expectations, and public responsibilities intersect [Paparella, Zanchetta 2022]. BIM applied to existing heritage enables the organization of relationships between geometric data, technical information, and management practices [Aheleroff et al. 2021].
In this sense, modeling a historical building means participating in a process of knowledge co-production involving different actors, professionals with heterogeneous skills,

administrations with governance responsibilities, and users engaged in everyday practices. Representation thus becomes the space where these pluralities meet, interact, and generate new perspectives for the care and enhancement of heritage.
In recent years, numerous studies have explored the use of HBIM, CDE, and digital twins for built heritage management, focusing mainly on the integration of survey activities, parametric modeling, and digital maintenance [Deng, Menassa, Kamat 2021; Paparella, Zanchetta 2022]. More recent experiments have also introduced immersive environments and collaborative platforms to support shared management and user engagement activities [Ćosović, Maksimović 2022; Mazzetto 2024]. Within this framework, the present contribution proposes an interpretation focused not only on the informational efficiency of the model, but also on its capacity to establish operational relationships among the different actors involved in heritage management.

Heritage as a system of relationships

Every process of heritage knowledge originates from a question. In the case of the palazzo del Governatore (fig. 1), this question did not arise solely from the building itself, but also from the institutional and social relationships that shape its daily use. The Public Administration of Parma, responsible for its preservation and operation, identified the need for a system capable of integrating information currently fragmented or obscured by management practices stratified over time. Requesting a digital model therefore meant seeking a new way to distribute knowledge and make accessible information previously stored in heterogeneous physical archives or entrusted to individual operational memory [Osello, Ugliotti 2022].
The request of the Public Administration was not limited to the creation of a BIM model, but also concerned the definition of a replicable method capable of enabling the city to organize, interpret, and share its architectural heritage coherently. Beyond integrating heterogeneous data, this method aimed to establish an operational framework capable of supporting transparency, management continuity, and shared responsibilities [Paparella, Zanchetta 2022].
The adoption of BIM was therefore defined according to the operational needs of the Public Administration, with the aim of organizing heterogeneous data within a shared and

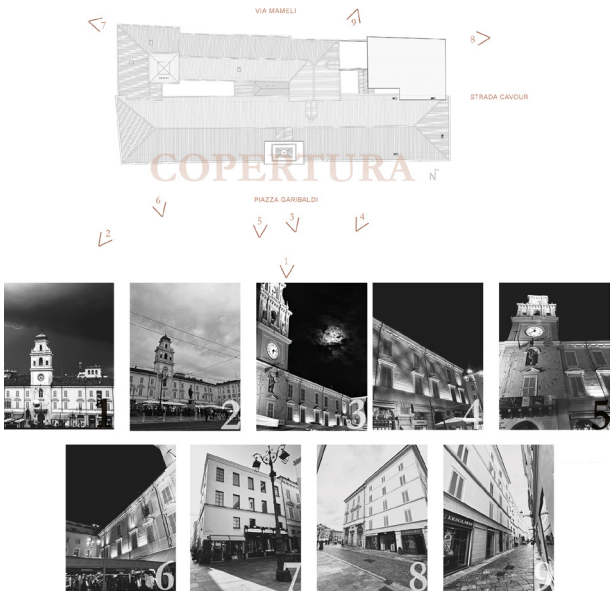


Fig. 1. Navigator plan with camera positions and view cones (top), and exterior photographs of the palazzo del Governatore (elaborated by the author).

continuously updatable system. The definition of common information schemes, priority criteria, accessibility levels, and updating processes was not merely procedural, but responded to the need to establish a shared language among different actors, capable of translating heritage into a readable and accessible system [Sacks et al. 2018].
During the preliminary phase, different information needs related to maintenance management, exhibition space organization, and technical consultation of the model were identified. This led to the definition of specific information categories and differentiated access modes according to the roles involved. In this sense, the initial phase of the research was not limited to the collection of requirements, but also acted as a collaborative process in which operational needs, regulatory constraints, functional uses, and cultural sensitivities were brought together to define a shared strategy. This approach is consistent with contemporary integrated heritage management practices, which interpret digital processes as spaces of negotiation between actors and competencies [Deng, Menassa, Kamat 2021].

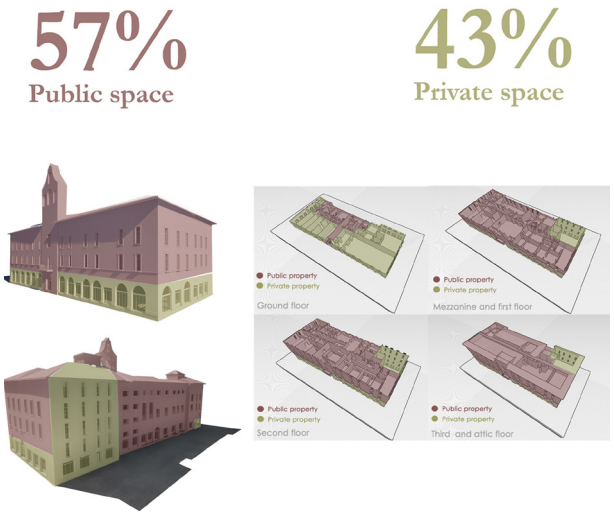


Fig. 2. Analysis of property typologies within the palazzo del Governatore (elaborated by the author).

The digital modeling of the palazzo del Governatore therefore emerged as the result of this collaborative process rather than as the mere application of a predefined protocol.

The case study: palazzo del Governatore as a node of social connections

The palazzo del Governatore, located in the historic center of Parma, represents not only a significant historical building of architectural relevance, but also a point of intersection between functions, communities, and management systems (fig. 2). Its selection as a case study was not determined solely by its typological complexity or its status as public heritage, but also by its ability to reveal the relational nature of heritage knowledge processes. This perspective is consistent with recent studies interpreting heritage as a dynamic system of relationships rather than as a collection of isolated objects [Mazzetto 2024].
Within the building coexist maintenance requirements, cultural activities, administrative dynamics, exhibition practices, public flows, and working spaces, each generating different information needs, behavioral patterns, constraints, and opportunities. This coexistence of functions required the development of an information model capable of supporting different activities, ranging from ordinary maintenance to the temporary management of exhibition layouts.
The development of the digital model made these relationships more visible, not because BIM provides an exhaustive representation of them, but because the modeling process itself requires critical decisions: which information should be made visible? Which relationships should be considered essential? Which elements deserve continuous monitoring? Which functions truly define the identity of the building? [Inzerillo et al. 2016]. Each modeling choice generated discussion among different actors, contributing to the construction of a model that is not only technical, but also narrative in nature.
The organization of the building –including exhibition spaces, offices, privately leased areas, and service zones– also highlighted the need for a multifaceted approach in which representation supports decisions related both to conservation and spatial organization. This dynamic reflects what the literature defines as 'interpretive modeling', namely the capacity of the model to incorporate different perspectives and needs [Aheleroff et al. 2021].
In this sense, the palazzo del Governatore is not merely the object of digitization, but the driving force of the process itself: the element that prompts reflection on the relationship between technology and heritage, between data and responsibility, and between measurement tools and forms of participation [Deng, Menassa, Kamat 2021].

Towards a socio-technical methodology of representation

The methodological approach adopted for the palazzo del Governatore in Parma originates from the awareness that heritage representation cannot be reduced to a set of standardized procedures. Instead, it requires a socio-technical methodology capable of integrating material, informational, and relational dimensions. This perspective is consistent with studies that recognize heritage digitization as a complex process shaped by negotiations and interpretative choices [Inzerillo et al. 2016; Paparella, Zanchetta 2022].
The process was structured into phases (fig. 3), not intended as a simple operational sequence, but rather as a system of actions, verifications, adaptations, and negotiations.

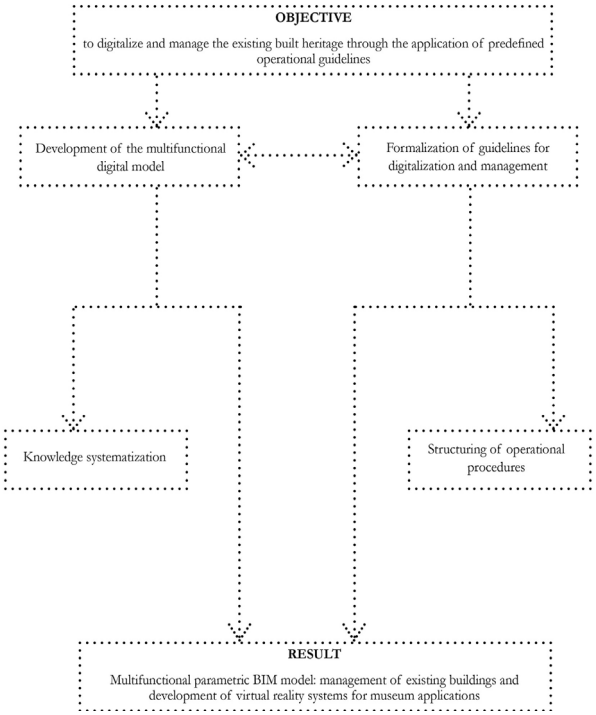


Fig. 3. Diagram of the workflow between the definition of objectives and the achievement of the intended results (elaborated by the author).

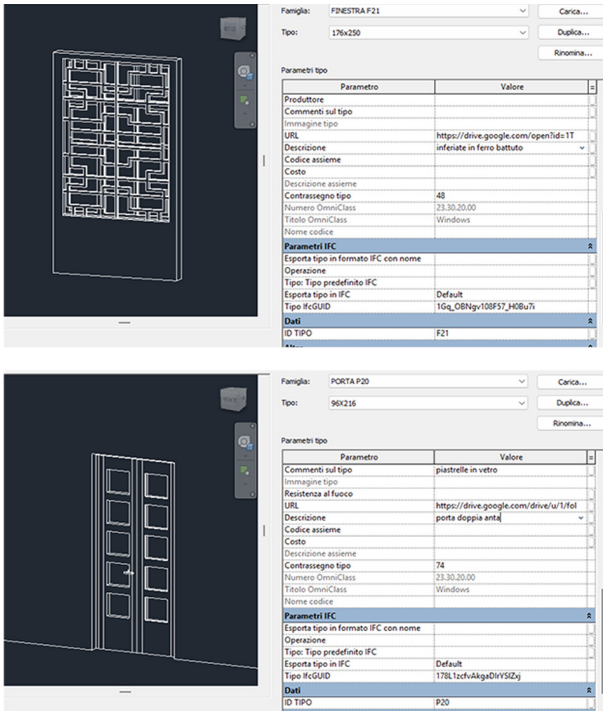


Fig. 4. Extracts from the BIM model of the palazzo del Governatore developed in Revit (elaborated by the author).

The first phase involved the identification, collection, and comparison of available information [Vernizzi, Droghetti 2025b]: existing surveys, historical and design documentation, maintenance data, operational requests from the Public Administration [1], and requirements related to cultural activities and exhibition setups. This initial complexity is widely acknowledged in the literature on BIM for existing heritage, which highlights how historical data are often heterogeneous and incomplete [Deng, Menassa, Kamat 2021]. This phase was not limited to data collection, but also required a critical evaluation of the quality, reliability, and consistency of the information, activating dialogue among the involved actors and verification procedures. This process reflects what several studies define as 'data lineage' in heritage management, namely the reconstruction of the origin and meaning of data [Aheleroff et al. 2021].

Before starting the modeling phase, a shared framework of the model's operational objectives was established. In the specific case of the palazzo del Governatore, the integration between technical and managerial dimensions was translated into specific operational choices. For example, during the definition of information parameters, exhibition spaces were organized not only according to geometric and material characteristics, but also in relation to temporary installation and maintenance requirements identified by exhibition curators. Similarly, the organization of data related to building systems and access management was defined according to the operational needs of municipal technicians responsible for the daily management of the building. The definition of accessibility levels within the CDE was also structured according to the different roles of the actors involved, distinguishing

between consultation, updating, and data management activities. In this sense, the model was not conceived as a static archive of information, but as a shared environment capable of supporting different practices of heritage use and interpretation. These choices directly influenced both the modeling workflow and the progressive organization of information within the model.

This process involved identifying the informational priorities of the Public Administration, selecting categories of elements relevant to maintenance activities, evaluating exhibition-space requirements, and defining data accessibility and updating levels. This methodological phase represented a central moment of the process because it enabled the transformation of heterogeneous needs into coherent information structures, avoiding models that were either excessively complex or overly simplified. The definition of informational 'use cases' is also recognized in major BIM guidelines and manuals [Sacks et al. 2018].

The modeling process was carried out according to criteria balancing geometric accuracy and informational functionality. The model was developed through clearly defined steps, including on-site verification of the existing survey, definition of the level of detail most suitable for management purposes, parameterization of significant objects (fixtures, systems, furniture, safety devices), and organization of metadata according to the intended uses. This approach reflects the literature on BIM applied to heritage, which emphasizes the importance of balancing accuracy and management sustainability [Bianchini, Inglese, Ippolito 2016].

Once completed, the model was transferred into a CDE (Common Data Environment), organized according to principles of information traceability, version management, and continuous updating. The environment also included differentiated role-based access and integration with maintenance records and external documentation (figs. 4, 5). Exporting the model in IFC format ensured future portability and independence from proprietary software, a condition considered crucial for the long-term preservation of digital heritage [Osello, Ugliotti 2022].

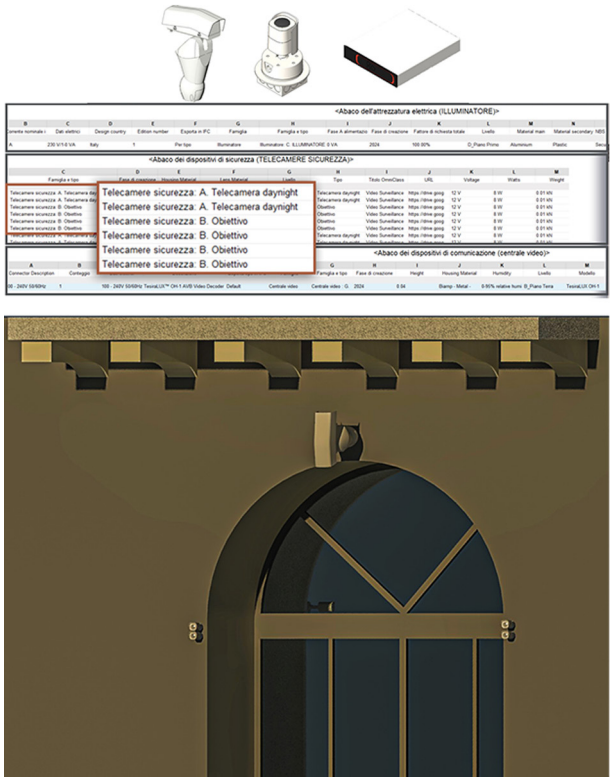


Fig. 5. Extract from the BIM model of the palazzo del Governatore developed in Revit (elaborated by the author).

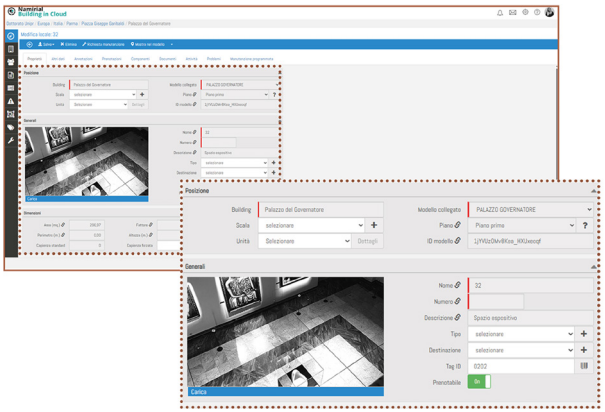


Fig. 6. Extract from the BIM model of the palazzo del Governatore developed in BiC (elaborated by the author).

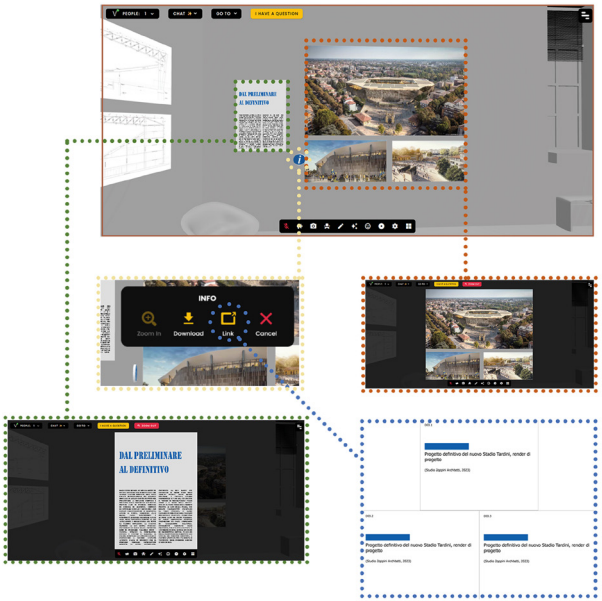


Fig. 7. Extract from the BIM model of the palazzo del Governatore developed in FrameVR (elaborated by the author).

This methodological phase addressed the need to establish a stable information ecosystem capable of supporting long-term management (fig. 6), as discussed in studies exploring the transition from BIM to digital twins [Aheleroff et al. 2021].
Alongside the modeling activities, experimentation with VR environments was conducted to test exhibition configurations, facilitate dialogue between technicians and curators, create inclusive heritage consultation tools, and support more accessible spatial understanding (fig. 7). VR was adopted as a methodological tool not for aesthetic purposes, but to open new scenarios of co-design, making the building explorable and interpretable by a wider audience. This use is consistent with the evolution of immersive technologies in cultural heritage studies [Ćosović, Maksimović 2022; Mazzetto 2024].
The process does not conclude with the creation of the model. Instead, the methodology includes a continuous updating system that allows the model to evolve in relation to the physical and functional transformations of the building. This perspective considers digital heritage as a living structure closely connected to real management practices –a central concept in digital twin models [Deng, Menassa, Kamat 2021]. The proposed methodology is not a rigid protocol, but a flexible approach that recognizes the complexity of heritage management processes. It is based on three central principles: interdisciplinarity –each phase requires different competencies capable of communicating with one another; knowledge co-production– representation emerges through dialogue among actors rather than from a single authority; and adaptability –the model must be capable of evolving over time alongside the life of the building. This methodology therefore proposes an integrated approach to heritage management based on the coordination between data, digital tools, and involved stakeholders.

Modeling and the negotiation of knowledge

Digital heritage modeling constitutes a space of mediation between operational needs, regulatory constraints, and management practices. This perspective is consistent

Fig. 8. Comparison between photographs and modeled elements of the palazzo del Governatore (elaborated by the author).

with the literature interpreting information models as interpretative tools rather than neutral copies of reality [Deng, Menassa, Kamat 2021].
Within existing heritage contexts, the BIM model organizes information useful for the management, maintenance, and shared consultation of the building. Choices related to the level of detail, information categories, and parameter structures directly influence the ways in which the model is used and updated (fig. 8). This interpretative dimension is recognized as an integral part of HBIM processes [Bianchini, Inglese, Ippolito 2016].
Modeling defines which information should be shared, updated, and made accessible over time. The introduction of shared information criteria also contributes to the construction of a common language among actors with different skills and responsibilities [Sacks et al. 2018].
The management of existing heritage also requires addressing recurring issues such as irregular geometries, subsequent transformations, and incomplete documentation [Inzerillo et al. 2016]. In the case of the palazzo del Governatore, the model was developed with particular attention to ordinary maintenance, building systems management, exhibition space organization, and the planning of public activities (fig. 9).
In this context, levels of detail become tools for defining different informational responsibilities and modes of data access. The model therefore takes the form of a shared platform capable of supporting different operational needs [Deng, Menassa, Kamat 2021].
Modeling existing heritage thus assumes the role of a coordination tool among actors with different competencies, fostering more transparent and shared forms of access to information. Ultimately, modeling does not simply mean constructing a 'digital twin', but organizing knowledge and practices related to built heritage management [Settis 2017] (fig. 10).

Digital management ecosystems

When a digital model enters a management environment, it transforms the ways in which heritage information is accessed, updated, and shared. Cloud platforms, interoperable formats, and immersive consultation tools influence decision-making processes, responsibilities, and modes of interaction among the actors involved [Osello, Ugliotti 2022].

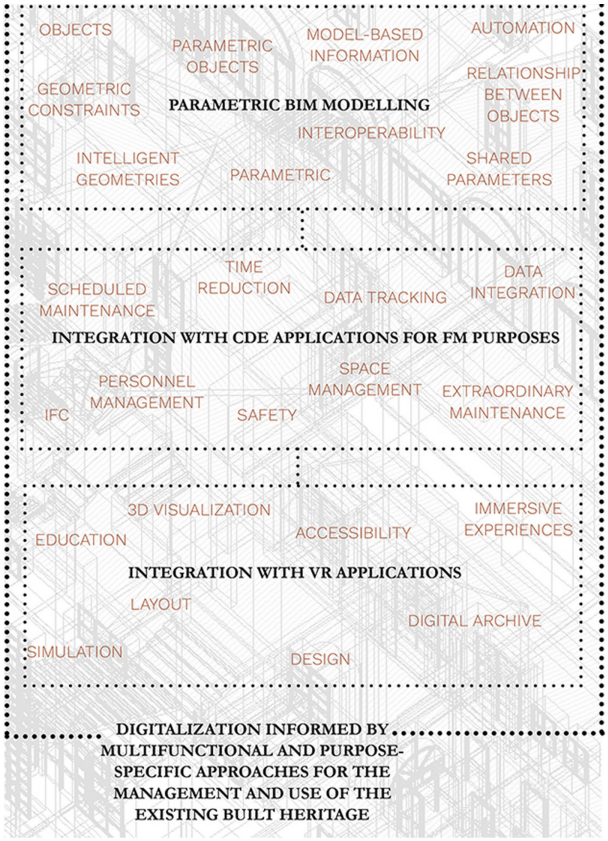


Fig. 9. Three key elements defining multifunctional BIM modeling for existing built heritage (elaborated by the author).

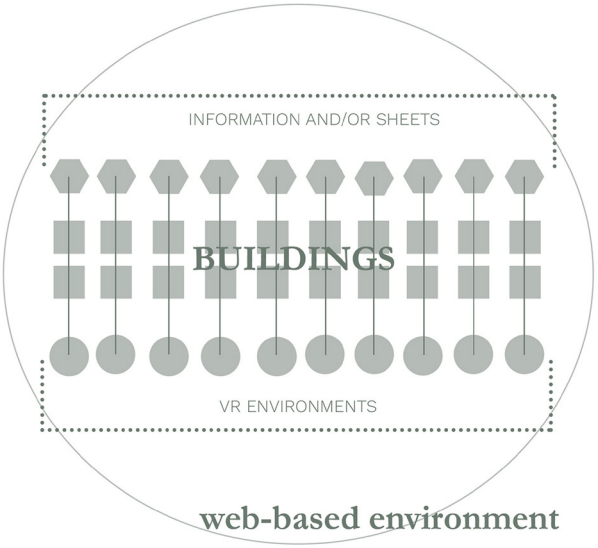
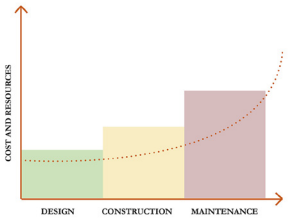


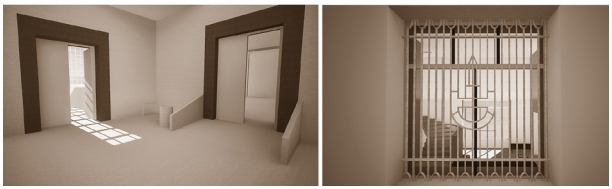
Fig. 10. Diagram of a possible web platform dedicated to the centralization and dissemination of digitized buildings (elaborated by the author).

In the case of the palazzo del Governatore, the adoption of a CDE (Common Data Environment) enabled the centralization of historical, technical, maintenance, and operational information within a shared and continuously updatable system. Within this environment, different actors –technicians, administrators, maintenance operators, and cultural professionals (fig. 11)– can access information according to their specific roles [Paparella, Zanchetta 2022]. At the same time, the adoption of the IFC format ensured interoperability and continuity in data management [Sacks et al. 2018].
Consultation through lightweight applications, mobile devices, and immersive environments also facilitated communication among actors with different competencies. Virtual reality was used to simulate exhibition configurations and support collaborative activities involving curators, technicians, and decision-makers [Ćosović, Maksimović 2022; Mazzetto 2024].
The experimentation conducted through the case study provided an initial qualitative verification of the proposed approach. The centralization of information within the

Fig. 11. Top. Diagram of the relationship between design and maintenance processes, alongside extracts from the BIM model of the palace (elaborated by the author).

Fig. 12. Bottom. Architectural plan of the second floor of the palazzo del Governatore and rendering visualization (elaborated by the author).





CDE facilitated shared model consultation and access to technical documentation, while immersive environments improved spatial understanding even for non-specialist users. Although these results do not yet constitute an extensive quantitative validation, they highlight the potential of the approach in supporting collaborative processes and integrated management practices.

Conclusions

The study conducted on the palazzo del Governatore (fig. 12) demonstrates how heritage digitization can become a process capable of expanding forms of architectural knowledge and care [Vernizzi, Droghetti 2025a]. Representation emerges as a space in which knowledge is not only collected and organized, but continuously reactivated through shared relationships and interpretations. In this sense, the digital model gains value not merely through the quantity or precision of data, but through its ability to generate connections between people, technologies, and institutions, configuring itself as a space where responsibilities and decisions emerge in a more transparent and negotiated way [Settis 2017].
The originality of the research lies in the adoption of a methodology integrating technical and social dimensions, overcoming the distinction between informational content and management processes. The model is not conceived as a purely descriptive tool, but as a narrative infrastructure capable of supporting multiple interpretations of the building and connecting maintenance activities, exhibition practices, and decision-making processes, in line with recent studies on the relationship between modeling, governance, and collaborative practices [Paparella, Zanchetta 2022].
The construction of an integrated digital ecosystem, based on interoperability, collaborative platforms, and immersive tools, fostered a more fluid relationship among the involved actors, introducing forms of collaboration rarely found in traditional management models. The results demonstrate how the shared organization of information and the use of interoperable environments can support coordination among stakeholders involved in heritage management, improving accessibility, consultation, and operational continuity. Experimentation with exhibition layouts also expanded the role of the digital model beyond its purely technical function. Moreover, adopting the perspective of the Public Administration gave the project a public and civic dimension, reinforcing attention toward transparency, operational continuity, and heritage accessibility [Osello, Ugliotti 2022].
Like any research based on a real case study, this experience also presents certain limitations related to the quality of pre-existing data, the need for continuous updating, and experimentation conducted on a single building, which does not yet allow extensive comparisons. Added to this is the rapid evolution of the technological context. These criticalities do not diminish the significance of the work, but rather highlight its dynamic and open-ended character [2].
Future perspectives include extending the methodology to other public buildings, developing integrated urban digital archives, and employing immersive tools to broaden accessibility and participation. Integration with monitoring systems and predictive models could transform the model into a dynamic organism, bringing it closer to the logic of heritage digital twins [Deng, Menassa, Kamat 2021; Aheleroff et al. 2021].
In conclusion, digital representation does not emerge as a final outcome, but as a point of convergence between memories, practices, and visions, capable of transforming heritage management into a collective exercise of care and interpretation [Mazzetto 2024].

Notes

[1] In this paper, the terms 'Public Administration' or 'PA' refer to the Public Administration of the Municipality of Parma.

[2] Within the proposed case study, several software platforms and applications were employed to support the experimental activities: Namirial Building in Cloud for management-related functions, Geo Twin by ACCA Software for additional data management and integration applications, BIMx for testing simplified yet information-rich navigation modes, and Frame VR as an immersive virtual reality environment.

Author

Virginia Droghetti, Department of Engineering and Architecture, University of Parma, virginia.droghetti@unipr.it

Reference List

Aheleroff, S., Xu, X., Zhong, R.Y., Lu, Y. (2021). Digital Twin as a Service (DTaaS) in Industry 4.0: An architecture reference model. In *Advanced Engineering Informatics*, No. 47. DOI: 10.1016/j.aei.2020.101225. <https://www.sciencedirect.com/science/article/abs/pii/S1474034620301944> (accessed 7 June 2026).

Bianchini, C., Inglese, C., Ippolito, A. (2016). Il contributo della rappresentazione nel Building Information Modeling (BIM) per la gestione del costruito. In *DisegnareCON*, No. 9(16), pp. 10.1-10.9. <https://disegnarecon.univaq.it/ojs/index.php/disegnarecon/article/view/152> (accessed 7 June 2026).

Ćosović, M., Maksimović, M. (2022). Application of the digital twin concept in cultural heritage. In A. Amelio, S. Montelpare, D. Ursino (Eds.). VIPERC 2022. *Visual Pattern Extraction and Recognition for Cultural Heritage Understanding. Proceedings of the 1st International Virtual Conference on Visual Pattern Extraction and Recognition for Cultural Heritage Understanding*. Online conference, 12-13 September 2022, paper 8, pp. 1-13. Aachen: CEUR Workshop Proceedings.

Deng, M., Menassa, C.C., Kamat, V. R. (2021). From BIM to digital twins: A systematic review of the evolution of intelligent building representations in the AEC-FM industry. In *Journal of Information Technology in Construction (ITcon)*, No. 26, pp. 58-83.

Inzerillo, L., Lo Turco, M., Parrinello, S., Santagati, C., Valenti, G.M. (2016). BIM and architectural heritage: Towards an operational methodology for the knowledge and the management of cultural heritage. In *DisegnareCON*, No. 9(16), pp. 16.1-16.9. <https://disegnarecon.univaq.it/ojs/index.php/disegnarecon/article/view/153> (accessed 7 June 2026).

Mazzetto, S. (2024). Integrating emerging technologies with digital twins for heritage building conservation: An interdisciplinary approach with expert insights and bibliometric analysis. In *Heritage*, No. 7 (11), pp. 6432-6479.

Osello, A., Ugliotti, F. M. (2022). *BIM verso il catasto del futuro: Conoscere, digitalizzare, condividere (il caso studio TO)*. Roma: Gangemi Editore International.

Paparella, R., Zanchetta, C. (2022). *BIM e digitalizzazione del patrimonio costruito esistente. Dai dati della costruzione alla costruzione del dato per la gestione interoperabile della manutenzione assistita*. Bologna: Esculapio.

Sacks, R., Eastman, C., Lee, G., Teicholz, P. (2018). *BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers*. Hoboken (NJ, USA): John Wiley & Sons.

Settis, S. (2017). *Architettura e democrazia: Paesaggio, città, diritti civili*. Torino: Einaudi.

Vernizzi, C., Droghetti, V. (2025a). Caratteristiche e contenuti della modellazione digitale rivolta alla gestione dell'edificio. In L. Carlevaris D. Calisi, L. Baglioni, C. Bianchini, M. Canciani, M.G. Cianci, L. Farroni, C. Inglese, M.F. Mancini, A. Meschini, J. Romor, M. Salvatore, G. Spadafora, G.M. Valenti (a cura di). *Èkphrasis. Descriptions in the space of representation*. Proceedings of 46th International Conference of Representation Disciplines Teachers. Rome, 11-13 September 2025, pp. 3433–3448. Milano: FrancoAngeli. DOI: 10.3280/oa-1430-c933.

Vernizzi, C., Droghetti, V. (2025b). From archival research to the digitization of existing architectural heritage: Methods and processes compared. In *DisegnareCON*, No. 18(34), pp. 4.1-4.12. <https://disegnarecon.univaq.it/ojs/index.php/disegnarecon/article/view/1343/691> (accessed 7 June 2026).