

Article

HBIM Models of Historic Buildings as a Subject of Copyright Protection: Licensing Challenges and Data Interoperability

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Abstract

The rapid development of Heritage Building Information Modelling (HBIM) has transformed digital models of historic buildings from design-support tools into long-term information assets used for documentation, conservation, and heritage management. Despite their growing importance, issues related to copyright protection, intellectual property rights, and data exchange remain insufficiently addressed in both research and professional practice. This study examines the legal status of HBIM models under European Union, especially Polish, copyright law and identifies challenges associated with licensing and interoperability in BIM environments. The research combines a doctrinal analysis of copyright legislation, a review of BIM and HBIM literature, an examination of information management standards, and a case study of an HBIM project developed for a listed historic property of the University of Wrocław. The findings indicate that HBIM models may qualify as copyright-protected works, most often of a joint authorship nature, requiring clear regulation of economic rights, derivative works, and model updates throughout the lifecycle of a heritage asset. The study also reveals a gap between technical and legal interoperability, as the IFC format does not consistently preserve information concerning authorship, licensing conditions, and revision history during data exchange. The results highlight the need to integrate copyright considerations into contractual arrangements, Common Data Environment (CDE) management, and metadata structures to support the lawful and sustainable long-term use of HBIM models in cultural heritage conservation.

Keywords: HBIM; copyright law; intellectual property; IFC; cultural heritage; digital twin

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1. Introduction

The dynamic development of digital technologies in the field of documentation, analysis, and management of built assets has led to the widespread adoption of the Building Information Model/Modelling/Management (BIM) methodology, which currently constitutes one of the fundamental standards for digital design and information management in the construction sector [1–3]. In recent years, intensive development of BIM applications in cultural heritage preservation has also been observed, resulting in the emergence of the Heritage Building Information Modelling (HBIM) methodology, adapted to the specific characteristics of historical and heritage buildings [4–6].

HBIM extends the traditional BIM approach by integrating geometric information with historical, material, diagnostic, and conservation data [7]. Consequently, an HBIM model serves not merely as a three-dimensional representation of a building but rather as a multi-layered information environment that enables the collection, analysis, and management of knowledge concerning a heritage asset throughout its entire lifecycle of use and conservation [8]. Increasingly, HBIM models are also referred to as digital twins of architectural heritage, providing a foundation for decision-making processes related to conservation, adaptation, and public dissemination of historic structures [9–11].

Unlike BIM models used for new construction projects, HBIM models are typically developed under conditions of considerably greater organizational and informational complexity. Heritage projects involve numerous stakeholder groups, including building owners, multidisciplinary designers, heritage conservation authorities, cultural institutions, contractors, researchers, and facility managers [12]. At the same time, HBIM models are characterized by long operational lifespans, encompassing successive stages of research, conservation works, renovations, and changes in building use. An additional factor is the high sensitivity of some of the data contained within these models, including information related to heritage values, structural conditions, construction solutions, and security systems [13].

Under these circumstances, the HBIM model ceases to function solely as technical documentation prepared for a specific project. Instead, it becomes an independent information asset of significant scientific, design, economic, and cultural value [14]. Moreover, such a model often contains not only survey and inventory data but also original historical interpretations, hypothetical reconstructions, analytical studies, and individual solutions concerning the structure and organization of information [15]. This raises questions regarding its legal status and the scope of protection granted to its creators [16,17]. Existing HBIM research primarily focuses on data acquisition, geometric modelling, and information management, while issues relating to copyright, co-authorship, and licensing of digital models remain marginally addressed in both academic literature and professional practice [18].

This issue becomes particularly significant within the BIM environment, whose fundamental principle is the sharing of information among multiple participants in the investment process. In practice, this entails the continuous transfer, updating, and modification of digital models by various stakeholders [19,20]. This process is further facilitated by the development of interoperability standards such as Industry Foundation Classes (IFC), which enable data exchange between different BIM platforms. However, while these standards address the technical aspects of information exchange, they do not regulate issues related to intellectual property rights, the scope of permissible model modifications, liability for model use, or the rights of individual contributors [21].

In the case of heritage assets, the issue becomes even more complex. HBIM models are often the result of interdisciplinary collaboration involving architects, conservation specialists, art historians, archaeologists, surveyors, BIM specialists, and engineering experts [22]. Individual model components may be created by different authors and subsequently integrated within a common information environment. Furthermore, some information contained within the model is reconstructive or interpretative in nature, raising questions concerning the copyright protection of historical interpretations and the legal status of digital reconstructions.

Despite the rapid development of HBIM research, the vast majority of publications focus on issues related to data acquisition, geometric modelling, information management, heritage documentation, and the application of digital technologies in heritage preservation [23–26]. Much less attention has been devoted to the legal aspects of HBIM models. In particular, the literature lacks comprehensive analyses concerning the

qualification of HBIM models as copyrighted works, the principles of co-authorship in BIM environments, the legal status of historical reconstructions, and the legal implications of data exchange through IFC formats. Consequently, a research gap exists at the intersection of digital heritage modelling, construction information management, and intellectual property law. Specifically, there is a lack of studies combining a doctrinal analysis of copyright law with an empirical case study of an actual HBIM project, taking into account real-world IFC data exchange procedures and the operation of a Common Data Environment (CDE) within the framework of the Polish public procurement system.

The aim of this article is to analyse the legal status of HBIM models used in the documentation, conservation, and management of architectural heritage, with particular emphasis on copyright, co-authorship, licensing, and data exchange within the BIM environment.

To achieve this objective, the following research questions were formulated:

1. Can HBIM models be classified as copyrighted works under Polish copyright law?
2. How are moral and economic rights structured in relation to HBIM models developed by multidisciplinary teams?
3. What legal issues arise in the case of historical reconstructions and derivative works based on existing models?
4. How does data exchange through the IFC format affect copyright protection and the scope of liability of project participants?
5. What organizational and licensing solutions can reduce the risk of intellectual property disputes in HBIM projects?

The research hypothesis assumes that HBIM models used in the conservation of architectural heritage may constitute copyrighted works protected under copyright law; however, their multi-author nature, the presence of interpretative components, and interoperable data exchange within BIM environments give rise to significant legal ambiguities that are not adequately addressed by current contractual and licensing practices.

It is assumed that the achievement of these objectives will not only systematize the currently fragmented issues concerning the legal status of HBIM models but will also enable the development of a coherent conceptual model of the HBIM model as a complex collaborative work, together with a set of practical contractual and organizational recommendations applicable to heritage conservation projects.

The accomplishment of the presented objectives will contribute to a better understanding of issues related to the functioning of HBIM models and facilitate the formulation of recommendations for design, conservation, and management practices regarding the protection of intellectual property rights within the domain of digital architectural heritage.

2. Current State of Knowledge and Legal Context of HBIM

2.1. HBIM as a Digital Heritage Information Asset

The development of Heritage Building Information Modelling (HBIM) technology has significantly transformed the way historic buildings are documented, analysed, and managed [27]. Initially, research focused primarily on scan-to-BIM processes, involving the conversion of data acquired through terrestrial laser scanning (TLS), photogrammetry, and other surveying methods into parametric digital models [28,29]. Over time, however, HBIM evolved from a documentation tool into a comprehensive information environment integrating geometric, historical, material, conservation, and operational data [30].

Contemporary HBIM models are increasingly regarded as digital twins of cultural heritage assets, used not only during documentation and design stages but also in

management processes, condition monitoring, conservation planning, and dissemination of heritage-related knowledge [31]. Consequently, an HBIM model becomes a long-term information asset of considerable economic, scientific, and cultural value [32].

As the importance of HBIM models increases, new issues arise concerning their legal status, intellectual property rights, and conditions for further use [33]. Unlike traditional architectural documentation, HBIM models are continuously developed, updated, and utilized by multiple participants involved in investment and conservation processes [34]. This creates a need to define rules governing the use of models, responsibility for their modification, and the scope of rights granted to individual stakeholders.

2.2. HBIM Models as Objects of Copyright Protection

A fundamental issue is determining whether an HBIM model may be classified as a copyrighted work.

According to Article 1 of the Polish Act on Copyright and Related Rights, a work is defined as any manifestation of creative activity of an individual character, established in any form [35]. This Act implements the directives of the European Communities within the scope of its provisions. In light of this definition, an HBIM model may be subject to copyright protection if its development requires creative and individual decisions made by its author.

In the case of heritage buildings, the criterion of creativity is particularly evident. These requirements are generally fulfilled because an HBIM model reflects individual creative decisions related to the interpretation of incomplete historical sources and hypothetical reconstructions, requires decisions regarding the scope and level of detail of representation, and integrates diverse information concerning the asset into a coherent information structure [36].

HBIM is not limited to the technical representation of survey data but also includes the interpretation of historical sources, reconstruction of missing parts of a building, definition of semantic relationships between model elements, and selection of an appropriate level of detail [37]. Consequently, the final form of the model results from a series of design and research decisions made by its creators [7].

In order to move beyond a purely abstract discussion of the “individual character” of HBIM models, this section has been supplemented with references to Polish case law and doctrinal commentary on the notion of a work and the threshold of creativity in architectural and technical documentation. Recent decisions of Polish courts confirm that works of an engineering or architectural nature may benefit from copyright protection where they reflect a sufficient level of creative, individual choices, in particular with respect to spatial arrangement, selection and organisation of elements, or the method of presenting technical information [38,39]. These criteria directly apply to HBIM models for heritage assets, which incorporate original interpretative decisions relating to incomplete historical sources, hypothetical reconstructions and the organisation of semantic information. These conclusions are consistent with the approach adopted in Polish case law and doctrinal commentary, which emphasise that even technical and engineering works may qualify as protected works when they incorporate individually shaped solutions and non-obvious choices in the selection and arrangement of elements [40].

The literature emphasizes that an HBIM model, combining geometry with historical, material, diagnostic, and conservation information, goes far beyond a simple collection of survey data. HBIM possesses a hybrid character. The hybrid nature of the HBIM model as both a complex structure and a knowledge base is illustrated in Figure 1. On the one hand, it constitutes a complex architectural and engineering work containing creative solutions related to the representation of a heritage asset [41]. On the other hand, it functions as a knowledge repository integrating geometric, historical, material, and

conservation information. This hybrid nature affects the determination of the scope of legal protection and the principles governing further use of the model while also having significant implications for defining fields of exploitation, relationships with database protection, and the regulation of rights related to model updates [25].

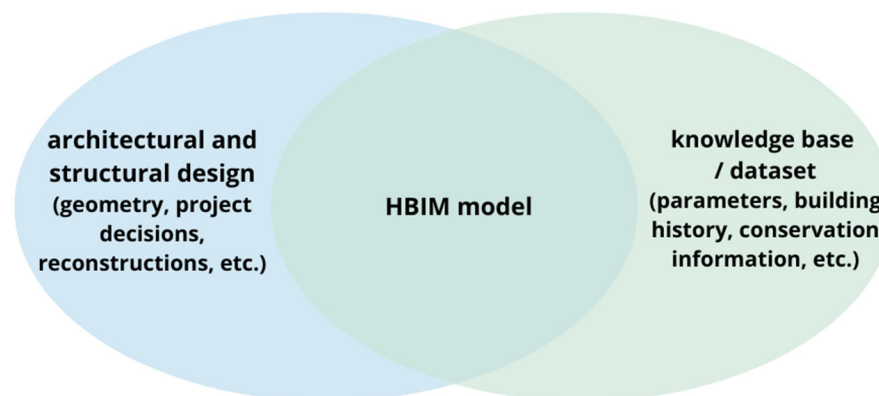


Figure 1. The hybrid nature of the HBIM model.

The HBIM model as an area where two domains overlap: the architectural and structural model (geometry, design decisions, reconstructions) and the database (parameters, building history, conservation information).

2.3. Co-Authorship and Rights in HBIM Models

A characteristic feature of HBIM projects is their interdisciplinary nature. Model development requires cooperation among specialists representing various fields of expertise, including architects, conservation professionals, structural engineers, MEP designers, surveyors, laser-scanning specialists, archaeologists, architectural historians, and material science experts [14].

In the Polish legal system, moral rights play a particularly important role in HBIM projects. Under Article 16 of the Polish Copyright Act, moral rights are non-transferable and cannot be waived, which fundamentally differentiates the Polish regime from many common-law jurisdictions where contractual waivers or limitations of moral rights are possible. This has direct consequences for HBIM, because the original authors retain, *inter alia*, the right to be identified as authors of their contributions and the right to the integrity of their works regardless of contractual arrangements concerning economic rights.

This inalienable character of moral rights also constrains the activities of model integrators, such as BIM coordinators, who combine and modify components originating from multiple authors within a unified HBIM model. While technical integration and coordination are necessary from a project-management perspective, extensive modifications of the geometry, removal of elements, or re-contextualisation of interpretative content may, in certain circumstances, be perceived as an interference with the integrity of the individual authors' works. Accordingly, model integration in HBIM projects should be accompanied by clear contractual provisions and BEP clauses defining permissible modifications, rules of attribution, and procedures for obtaining prior consent from contributors where substantial changes to their contributions are envisaged.

Where the contributions of individual participants form an inseparable whole, the model may be classified as a joint work. According to copyright law, co-authors jointly hold economic copyright, and their shares are presumed equal unless otherwise agreed by the parties [35].

HBIM projects frequently encompass different categories of intangible assets that may be subject to distinct legal protection regimes. The main types of intangible assets identified in HBIM projects are summarised in Table 1.

Table 1. Typology of intangible assets occurring in HBIM projects and their legal status within the analysed case study.

Asset Type	Example in an HBIM Project	Legal Basis	Status in the Analysed Project
HBIM Model (integrated model)	Historic building model in IFC/Revit format	Copyright-protected work	Licence granted/not fully regulated
Geometric Documentation	Point cloud, 3D mesh	No copyright protection/database right	Not regulated
Parametric BIM Elements	Revit families (e.g., windows, columns)	Copyright-protected work	Limited licence
Information Attributes	Material and technical data	Database	Internal access only
Archival Documentation	Scans of maps and drawings	Copyright-protected work/public domain	Archival licence
Conservation Documentation	Conservation analyses and reports	Copyright-protected work	Transfer of rights/licence
Visualisations	Renderings, animations	Copyright-protected work	Marketing licence
Clash Detection Reports	Navisworks/Solibri reports	Copyright-protected work/no protection	Not regulated
Classification Structure	HBIM coding and classification system	No copyright protection/database	Not regulated
Project Metadata	CDE data and records	Database	Organisation-owned

In HBIM projects, moral rights are also of particular importance [42]. The right of authorship requires the identification of model creators and the preservation of information regarding their contributions during data exchange between different BIM platforms and throughout multiple IFC export processes [43,44]. The right to integrity of the work may limit the possibility of introducing significant modifications without the author's consent, particularly when such changes affect the interpretation of the heritage values of a building. The right to supervise the use of a work may also be invoked where an HBIM model is used in a manner inconsistent with conservation principles, for example in promotional or commercial activities that distort the historical context of a heritage asset [5].

This issue becomes particularly significant in long-term conservation projects, where an HBIM model is continuously developed by successive design teams and used by various stakeholders over many years. Figure 2 illustrates the contributions of individual specialists to the development of the HBIM co-authored model.

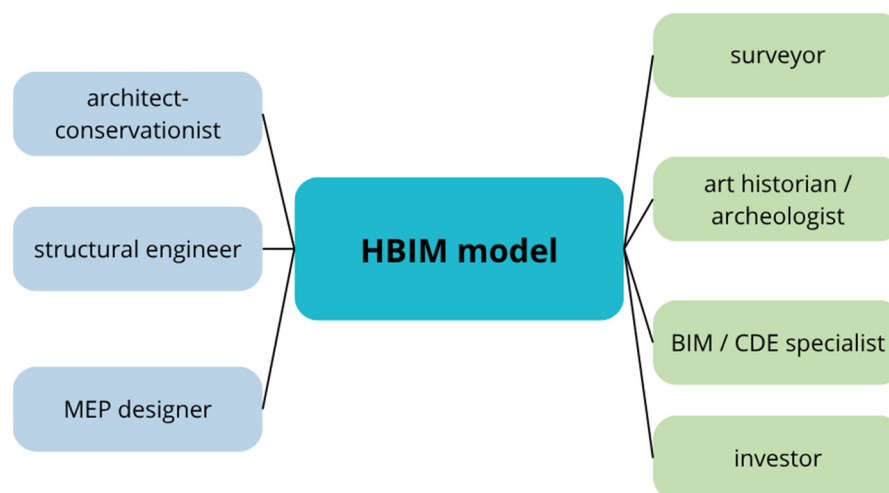


Figure 2. Interdisciplinary co-authorship in HBIM.

This inalienable character of moral rights also constrains the activities of model integrators, such as BIM coordinators, who combine and modify components originating from multiple authors within a unified HBIM model. While technical integration and coordination are necessary from a project-management perspective, extensive modifications of the geometry, removal of elements, or re-contextualisation of interpretative content may, in certain circumstances, be perceived as an interference with the integrity of the individual authors' works and thus require explicit consent or carefully drafted contractual arrangements.

2.4. Licensing Challenges and Data Exchange in the BIM Environment

One of the most frequently identified issues associated with BIM implementation concerns the ambiguity surrounding ownership of digital models and the scope of licences granted to project participants [17,45].

In practice, it is essential to distinguish between rights related to a model developed for a specific project and rights associated with libraries, templates, BIM families, and other solutions constituting the designer's pre-existing intellectual property. The absence of clear contractual provisions may lead to disputes concerning the further use of the model, its modification, and the creation of derivative works [46].

Additional challenges arise within the open BIM environment, where information exchange is carried out through the Industry Foundation Classes (IFC) format [47]. Although IFC ensures interoperability between different design platforms, the standard was not developed with copyright management in mind [48]. As a consequence, information regarding authorship, revision history, or licensing conditions assigned to a model may be lost during export and data exchange processes [46].

This issue is particularly important in cultural heritage projects, where an HBIM model functions as a long-term repository of knowledge about a heritage asset and may be used by multiple stakeholders over several decades.

3. Research Methodology

The aim of the study was to identify and analyse issues related to copyright protection, licensing, and data exchange in the HBIM environment, with particular emphasis on historic buildings and structures. Due to the interdisciplinary nature of the subject, encompassing both legal and technical aspects, a research approach combining normative analysis, industry-standard analysis, and a case study of a real HBIM project was adopted.

The study is qualitative in nature and combines elements of legal-dogmatic analysis with an empirical analysis of HBIM project documentation. This approach makes it possible to compare requirements arising from the legal framework with actual information management practices in the BIM environment. The research process was divided into four complementary stages:

1. analysis of copyright regulations and the relevant literature,
2. analysis of BIM standards and data exchange mechanisms,
3. a case study of an HBIM project developed for a historic building,
4. synthesis of results and development of a conceptual model.

Individual research questions were linked to specific methods. Research Questions 1–3, concerning the qualification of HBIM models as copyrighted works and issues of joint authorship, were examined primarily using the legal-dogmatic method. Research Question 4, relating to IFC-based data exchange, was addressed through a review of BIM standards and software technical documentation. Research Question 5, concerning organisational and licensing recommendations, was developed based on the findings of the case study and a synthesis of observed contractual practices.

This approach enabled the comparison of legal requirements with the practical implementation of HBIM projects and facilitated an assessment of the extent to which current standards support copyright protection and intellectual property management for digital models.

3.1. Analysis of Copyright Regulations and Literature Review

The first stage of the research consisted of a legal-dogmatic analysis of the provisions of the Polish Copyright and Related Rights Act and of the literature concerning the protection of architectural works and design documentation.

Particular attention was devoted to the qualification of HBIM models as copyright-protected works, issues of joint authorship and the allocation of authorship, moral and economic copyright, derivative works, licensing and the transfer of rights, database protection, and the legal implications of long-term information management.

The analysis was based on statutory provisions, legal commentaries, and studies addressing the protection of architectural and construction designs, project documentation, and BIM models as objects of intellectual property [32,45,49].

The outcome of this stage was the identification of the legal categories applicable to HBIM models and the determination of potential areas of legal conflict arising during the creation, development, and use of digital heritage models.

3.2. Analysis of BIM Standards and Data Exchange Mechanisms

The second stage of the research involved an analysis of standards and technical documents governing information management in the BIM environment.

The analysis covered:

1. information management standards, particularly ISO 19650, with regard to roles, responsibilities, and information management processes [50,51],
2. literature addressing HBIM workflows, object libraries, and digital twins of cultural heritage assets [52–54],
3. technical documentation of the IFC (Industry Foundation Classes) standard [55–57],
4. BIM software vendor guidelines concerning model exchange and metadata management [58–61].

Particular attention was devoted to identifying mechanisms that support the preservation of information related to authorship, data ownership, and model modification history during information exchange between different BIM platforms.

The objective of this analysis was to assess the extent to which currently applied standards and data exchange formats support compliance with copyright requirements and to identify limitations encountered in HBIM practice.

3.3. Case Study of an HBIM Project for a Historic Building

The third component of the research consisted of a case study of an HBIM project developed for the historic Botanical Garden complex of the University of Wrocław, Poland.

The case was selected based on the following criteria:

- the facility is listed in the register of historic monuments (providing a strong legal protection framework),
- the use of the HBIM methodology for documentation, design, and facility management purposes,
- the multidisciplinary nature of the project, involving numerous disciplines and specialists in the modelling process, including a conservation architect, structural engineer, MEP designer, and 3D scanning specialists,
- the use of a Common Data Environment (CDE),
- data exchange implemented through the IFC format.

The analysis focused on the organisational and technical documentation of the project, including contractual provisions, the BIM Execution Plan (BEP), data exchange procedures and specifications, and metadata structures in both native BIM models and IFC files.

The conducted analysis enabled the identification of practical issues related to model authorship, the management of rights concerning model modifications, and the preservation of information regarding data provenance during exchanges between different design environments.

3.4. Synthesis of Results and Development of a Conceptual Model

In the final stage, the results of the legal analysis, BIM standards review, and case study were synthesised.

Based on this synthesis, the following outputs were developed:

- a conceptual model of the HBIM model as a complex jointly authored work,
- a map of “legally significant” events occurring throughout the life cycle of both the historic asset and the HBIM model (creation, modification, exchange, and publication),
- identification of the principal risks associated with data exchange and intellectual property management,
- a set of recommendations concerning contractual provisions, HBIM process organisation, and the management of copyright-related metadata.

The legally significant events in the HBIM model’s lifecycle and the associated risks are presented in Table 2.

Table 2. Legally Significant Events in the HBIM Model Lifecycle.

Lifecycle Phase	Legally Significant Event	Potential Risk	Example Practical Consequence
Model Creation	Creation of a copyright-protected work	Dispute over authorship	Inability to commercially exploit the model
Multidisciplinary Integration	Integration of models created by different authors	Derivative work/joint authorship issues	Requirement to obtain consent from all authors for further use
IFC Exchange	Data export/import	Loss of metadata	Incorrect design decisions or coordination clashes

Reuse	Reuse of the model or its components	Licence infringement	Financial claims by the copyright holder
Archiving/ Dissemination	Publication in a CDE or repository	Unauthorized distribution	Legal liability of the owner/client

The adopted methodology enabled the integration of legal and technical perspectives, allowing copyright protection mechanisms to be assessed not only at the level of formal regulations but also within real-world processes of creating and using HBIM models. It should be noted, however, that the findings primarily relate to the Polish legal system and the analysed project. Nevertheless, the identified patterns of challenges are representative of typical HBIM projects implemented within the framework of public procurement procedures.

In order to increase the transparency and reproducibility of the empirical component, a simple qualitative coding scheme was applied to the analysed materials, including contractual documents, the BIM Execution Plan, CDE records and BIM/IFC files. Observations were grouped into the following categories:

- authorship information,
- licence terms and scope of rights,
- revision history and model update procedures,
- reuse conditions, and
- presence, transformation or loss of copyright-related metadata during IFC-based data exchanges.

The same categories were used to structure the analysis of IFC metadata structures, focusing in particular on how information on authorship, ownership and licensing is represented—or not represented—in standard IFC entities and property sets.

4. Case Study: HBIM Model of a Historic Building of the University of Wrocław

4.1. Characteristics of the Building and the HBIM Project

The case study was conducted using an HBIM project developed for the greenhouse complex of the Botanical Garden of the University of Wrocław, located at 23 Sienkiewicza Street in Wrocław, Poland. The site is listed in the register of historic monuments under entry No. A-2374/209/4 by decision of 5 February 1974 and constitutes part of a historic garden complex of significant cultural and scientific value. The selection of the Botanical Garden of the University of Wrocław corresponds to the assumptions of qualitative HBIM research: it is a legally protected heritage site, implemented through a multidisciplinary project based on a Common Data Environment (CDE) and IFC workflows, and conducted under a public procurement framework typical of Poland, thereby allowing the identification of recurring copyright-related issues. The analysed project represents an instrumental case study; it was selected not because of its uniqueness, but because it reveals, in a condensed form, issues commonly encountered in Polish HBIM projects regarding copyright, IFC data exchange, and the operation of a CDE.

The former greenhouse complex known as Palm House—Victoria—Australia, established in the nineteenth century, gradually deteriorated due to technical degradation. Owing to the poor condition of the structure and the lack of funding for comprehensive conservation works, it was demolished in 2013. Only fragments of the Australia greenhouse structure were preserved, including wrought-cast iron columns, elements of the steel roof lantern structure, and the stone basin of the Victoria greenhouse, together with four corner basins and masonry walls finished with stone coping.

The HBIM project was implemented as a multidisciplinary undertaking involving collaboration among architects, structural engineers, MEP designers, surveyors, and specialists in laser scanning and photogrammetry. The modelling workflow included:

1. acquisition of survey data using terrestrial laser scanning and photogrammetry,
2. registration and processing of point clouds,
3. generation of orthophotoplans,
4. geometric modelling within a BIM environment,
5. development of dedicated object families for historic structural elements,
6. assignment of descriptive information concerning materials, historical phases, and technical parameters,
7. integration of architectural, structural, and building services data.

The flow of information and models in the HBIM project developed for the greenhouse complex of the University of Wrocław Botanical Garden is illustrated in Figure 3.

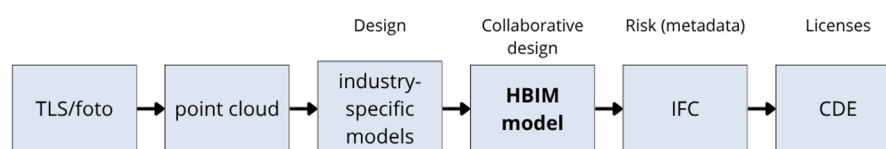


Figure 3. Data Workflow in the Case Study (University of Wrocław Botanical Garden).

Simplified diagram of data and model flows within the HBIM process, identifying key points at which copyright-protected works are created, as well as legal risks associated with interoperability and information sharing.

The resulting model served both as a design tool supporting variant analyses and as a digital repository of knowledge representing the condition of the heritage asset at the completion of the inventory process.

4.2. Analysis of Copyright Relationships

The project was implemented under a public procurement contract. Analysis of the contractual documentation revealed that the main agreement employed the general term “design documentation” without clearly defining the legal status of HBIM models.

In particular, the contract did not specify the types and formats of digital models to be delivered (native files, IFC files, point clouds), the scope of economic copyright transferred in relation to HBIM models, the rules governing the creation and use of derivative works, and responsibility for future model maintenance and updating after project completion.

The analysis further demonstrated that although the contracting authority obtained rights to use the design documentation, no explicit distinction was made between the model developed for the specific project and the object libraries, templates, and components constituting the designers’ pre-existing intellectual property. The structure of contractual relationships and the resulting rights to the HBIM model are presented in Table 3.

Table 3. Contractual Relationships and Model Rights in a Case Study.

Entity	Role in the Project	Scope of Work	Scope of Rights to the HBIM Model	Identified Gaps/Limitations
Investor	Contracting Authority	Financing, definition of project requirements	Often a non-exclusive licence	No full transfer of rights

Architectural Designer	Author of the base model	Development of the HBIM model	Full copyright ownership or partial transfer of rights	Licensing restrictions
Discipline-Specific Designers	Co-authors	Discipline-specific models (MEP, structural, etc.)	Rights to their own model components	Risk of joint authorship issues
BIM Coordinator	Information management	Model integration, CDE management	Limited technical rights	No copyright to the integrated model as a whole
Contractor	Project execution	Updating the model (as-built model)	Dependent on contractual provisions	Lack of regulations concerning the as-built model
Technology Providers	Technical support	BIM tools and components	Software licences	No rights to project data
Facility Manager	Operation and maintenance	Model maintenance and updates	Typically a user licence	Restrictions on model modification

Moreover, agreements concluded with subcontractors (structural engineering, building services, and scanning contractors) provided only non-exclusive licences to the project leader, without transferring rights to the integrated model as a whole. The agreements also failed to define responsibility for long-term model stewardship or procedures for updating the model in future projects.

As a result, the University of Wrocław acquired the ability to use the model for the purposes of the commissioned project; however, no coherent framework for copyright management throughout the entire life cycle of the HBIM model was established.

4.3. Data Exchange and the Problem of Copyright Metadata

An important component of the project was information exchange between project participants through a Common Data Environment (CDE) and the IFC format. Within this framework, the HBIM models of the historic greenhouse complex were exchanged between different BIM platforms used by architects, structural engineers and MEP designers. The technical interoperability provided by the IFC standard ensured that the geometric representation and most technical parameters of the models were successfully transferred. However, a closer examination of “before-and-after” states of the models, i.e., the native HBIM files before export and the IFC files after export and re-import, revealed that certain categories of descriptive information were not consistently preserved. This issue particularly affected metadata relating to authorship, revision history and licensing conditions.

Three principal problems were identified. First, there was no standardised set of properties describing copyright ownership or licensing conditions for individual model elements. In practice, this information was only partly recorded in native BIM environments, often by means of custom parameters or textual notes, and it was not mapped to IFC entities or property sets in a systematic manner. Second, partial loss of information concerning authorship and modification history occurred during IFC exchange, because some software platforms did not export, or only partially exported, extended provenance data and audit trails. Third, models were transferred between stakeholders without clearly defined conditions governing further use in the metadata of the exchanged files, which meant that the legal context of the model remained detached from the exchanged technical data.

The gap between technical and legal interoperability, resulting from the loss of metadata during IFC export, is illustrated in Figure 4.

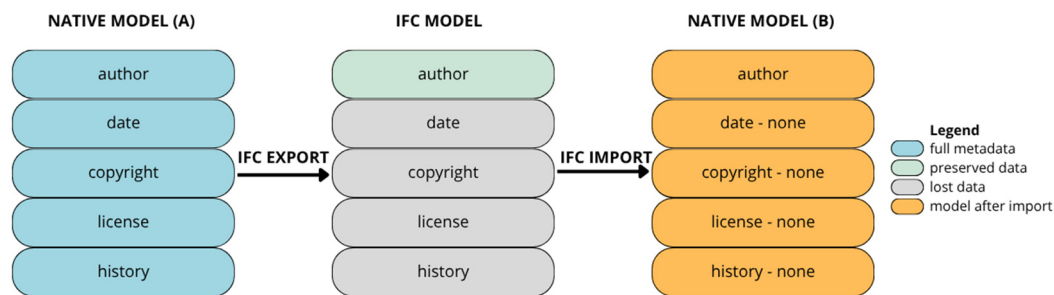


Figure 4. The gap between technical and legal interoperability (IFC). Metadata degradation during the export and re-import of an IFC model: comparison of the native model before and after data exchange, and identification of information loss relevant to copyright management.

Figure 4 illustrates one of the most representative “before-and-after” cases observed in the project. In the native HBIM model (before export), the “Author” and “Discipline” fields were populated for individual model elements, and a custom parameter was used to record a short copyright notice and licence information. After export to IFC and re-import into another BIM platform, the “Author” field (after import) became empty or was replaced with a generic project identifier, while the copyright-notice parameter was not mapped at all. Additional screenshots from the BIM software and CDE show similar patterns of loss or generalisation of revision-history and licence-related metadata during IFC-based exchanges.

These findings confirm that there is a significant gap between technical and legal interoperability in current HBIM workflows. From a purely technical perspective, the IFC-based exchange is successful: the model remains usable for design coordination, clash detection and quantity take-off. From a legal and organisational perspective, however, the degradation or disappearance of authorship and licensing information during model exchange makes it difficult to identify rights holders, verify the scope of permitted uses and ensure that the moral and economic rights of the contributors are respected. Consequently, subsequent versions of the models function primarily as carriers of technical information, while information relevant to intellectual-property management remains dispersed across project documentation and contractual records instead of being embedded in a persistent, machine-readable metadata layer.

The main patterns of preservation, generalisation and loss of copyright-relevant metadata observed in the case study are summarised in Table 4. The table compares the state of selected metadata fields in the native HBIM model before export, in the IFC file after export and in the model after IFC re-import, indicating whether the information is fully preserved, partially preserved in a more generalised form, or completely lost.

Table 4. Preservation and loss of copyright-relevant metadata during IFC-based exchanges in the case study.

Metadata Field/Information Category	Native HBIM Model (Before Export)	IFC File (After Export)	Imported Model (After IFC Re-Import)	Observed Effect
Author	Filled with individual author name or team identifier for each model element	Sometimes mapped as a generic project-level attribute	Empty or replaced with a generic project identifier	Loss of detailed authorship information for individual elements
Date/creation timestamp	Element-level creation and/or modification date stored in BIM software	Not exported	Available only at file level, missing at element level	Generalisation of temporal provenance from element level to file level

Copyright notice	Custom parameter with short text (e.g., © + rights holder, year, licence reference)	Not mapped to any IFC entity or property set	Absent	Complete loss of explicit copyright notice in exchanged models
Licence/reuse conditions	Recorded in project documentation or custom parameters attached to the HBIM model	Not systematically mapped; occasionally present in project-header notes	Not visible in element properties or standard IFC property sets	Licence information detached from model elements and available, if at all, only in external documents
Revision history	Detailed revision log and comments maintained in the BIM software revision system	Only latest status code or generic revision identifier exported (if any)	Only partial information available, without detailed revision notes	Strong reduction or loss of detailed revision-history metadata

4.4. Findings of the Case Study

The conducted case study confirms that a significant gap exists in HBIM projects for historic buildings between the formal system of copyright protection and the practical management of digital models.

The most important identified issues include:

- the lack of a clear definition of the legal status of HBIM models within contractual documentation,
- insufficient regulation of derivative works and model updating procedures,
- fragmentation of authorship information among different project participants,
- inadequate support for copyright-related information within current data exchange standards.

The findings indicate that the effective use of HBIM as a long-term information asset requires the simultaneous implementation of organisational, contractual, and technical measures capable of preserving information regarding authorship and conditions of use throughout the entire life cycle of the model.

5. Discussion

5.1. HBIM Models as Works and Objects of Copyright Protection

The analysis conducted demonstrates that HBIM models meet the criteria for classification as works within the meaning of Article 1 of the Polish Copyright and Related Rights Act [35]. Although they are based on survey data acquired through terrestrial laser scanning and photogrammetry, among other methods, the final form of the model does not constitute a mere representation of reality but rather the outcome of a series of creative decisions made by its authors.

In particular, the creative nature of an HBIM model is manifested through the interpretation of historical sources, reconstruction of missing elements, determination of the modelling scope, and organization of semantic information. This phenomenon is especially evident in HBIM projects concerning heritage assets, where source documentation is often incomplete and the modelling process requires numerous expert judgments.

The findings therefore support the position advanced in the literature that HBIM models should be regarded not merely as collections of technical data but as complex informational works subject to copyright protection [14].

The research identifies three principal contributions of this study to the fields of HBIM and copyright law. First, it proposes a conceptualization of HBIM models for heritage assets as complex joint-authorship works integrating contributions from

architects, conservators, engineers, and digital documentation specialists, thereby extending existing discussions on BIM ownership into the heritage domain. Second, it identifies a systemic gap between technical interoperability and legal interoperability in HBIM models, demonstrating how the loss of authorship and licensing metadata during IFC exchanges undermines the lawful long-term use of models. Third, it develops a set of contractual recommendations, BEP provisions, and metadata requirements that may serve as a foundation for establishing best-practice frameworks for HBIM projects in the architectural heritage sector.

In the absence of detailed statutory regulations, contracts become the primary mechanism for defining rights to an HBIM model [18,62]. From the perspective of heritage asset management, this means that the drafting of BIM/HBIM contracts determines whether a model becomes a long-term information asset or merely a by-product of a single investment project whose future reuse remains legally uncertain.

Recent research increasingly conceptualises HBIM models as foundations for heritage digital twins that incorporate real-time monitoring, sensor data and continuous updates [63,64]. In this article, the legal and empirical analysis focuses primarily on HBIM models as they are currently implemented in practice, that is, as structured repositories integrating geometric, historical and conservation information rather than fully dynamic digital-twin systems. While many of the conclusions regarding copyright, ownership and licensing are likely to be relevant for heritage digital twins, the specific legal implications of live data streams, automated model updates and sensor integration require separate analysis and are therefore identified as a limitation of the present study.

5.2. Joint Authorship and the Fragmentation of Rights

The case study analysis revealed that HBIM projects are characterized by a high degree of joint authorship. In the examined project, creative contributions were provided by architects, structural engineers, MEP designers, laser scanning specialists, and surveyors.

Despite the existence of a common project objective, rights to individual parts of the model were not clearly regulated. Subcontractor agreements primarily provided non-exclusive licences to the project leader but did not define the conditions under which the contracting authority could further use the model after completion of the investment.

As a result, a situation emerged in which the public institution obtained access to the model and the right to use it for the immediate project, yet did not secure full control over future modifications. This issue is particularly significant for heritage assets, whose lifecycle substantially exceeds the duration of any individual investment project.

From the perspective of a heritage asset owner or manager, licensing provisions are of fundamental importance. First, licences should clearly define what constitutes the “work” within a given project—whether this refers solely to the integrated model or also includes object libraries, IFC exports, visualizations, and derivative documentation. Second, licences should encompass broad fields of exploitation extending beyond design and construction to include operation, facility management, research activities, and public dissemination of information. Third, given the long lifecycle of heritage assets, contracting authorities should be explicitly granted the right to create derivative works, including subsequent versions and updates of HBIM models, whether developed internally or through externally commissioned interventions.

Without such licensing arrangements, any subsequent project affecting the model (e.g., MEP modernization, a new conservation campaign, or the implementation of facility management systems) may generate uncertainty regarding the legality of HBIM updates.

In construction practice, non-exclusive licensing remains the dominant approach, protecting designers’ interests in reusing their know-how and libraries. In the context of

HBIM for heritage assets, however, excessive fragmentation of rights to the integrated model may hinder identification of the authoritative “reference version” of the digital twin, encourage the emergence of conflicting versions, and complicate responsibility for the accuracy of data used in conservation decision-making.

From the perspective of public interest and public ownership, it therefore appears justified to pursue exclusive or quasi-exclusive economic copyright ownership of the integrated model by the heritage-managing institution, while preserving designers’ non-exclusive rights to their proprietary libraries and tools.

5.3. IFC Data Exchange and the Continuity of Copyright Information

One of the most significant findings of the study is the identification of a structural gap between the technical interoperability and legal interoperability of HBIM models. The IFC standard enables efficient exchange of geometric and semantic data between different BIM platforms; however, it does not guarantee the preservation of information concerning authorship, licensing conditions or permitted uses of the model. The “before-and-after” analysis of native HBIM files and IFC-based exchanges in the Botanical Garden project revealed concrete instances of metadata loss during export and re-import, as well as the absence of consistent procedures for documenting the legal status of exchanged files.

In practical terms, this means that technical interoperability achieved through IFC is not equivalent to legal interoperability. A model may remain fully readable and technically usable across different BIM applications, for design coordination, clash detection or quantity take-off, while simultaneously losing information that is necessary to determine who holds rights to the model, under what conditions it may be reused and who is responsible for subsequent modifications. The empirical examples discussed in Section 4.3 demonstrate that, after IFC-based exchanges, fields such as “Author” or copyright notices may become empty, generic or entirely unmapped, and that revision-history and licence-related metadata are often not preserved in a machine-readable form. These patterns are consistent with the results summarised in Table 4, which shows, for each key metadata field, whether it is preserved, generalised or lost across the native model, the IFC file and the imported model.

To make this gap more explicit, the Discussion presents a tabular comparison of selected IFC entities and property sets, indicating which attributes are fully preserved, which are generalised and which disappear entirely during IFC-based exchanges in the case study. This comparison shows, for example, that provenance-related attributes such as detailed author identifiers, copyright notices and revision comments are not consistently carried over into the IFC schema or are reduced to generic project-level entries. In consequence, the legal context of HBIM models is maintained, if at all, primarily in external documents (contracts, BEP, CDE manuals), while the exchanged IFC files function mainly as carriers of technical data.

As an open data-exchange standard, IFC is essential for ensuring interoperability, portability and long-term accessibility of HBIM models. At the same time, current IFC specifications and implementations do not require the consistent preservation of information concerning authorship, licensing and usage restrictions. Many BIM applications do not map internal “author/copyright/licence” fields into IFC entities or property sets, and the absence of heritage-specific IFC profiles means that conservation-related requirements and copyright-management needs remain outside the scope of the core standard. This creates a situation in which IFC-based exchanges, while technically successful, weaken the continuity of copyright information and increase the risk that HBIM models will be reused without a clear understanding of their legal status.

From the perspective of HBIM practice, this gap between technical and legal interoperability has at least two important implications. First, project participants cannot

rely on IFC files alone to reconstruct the chain of authorship, ownership and licensing conditions, which increases the risk of disputes and undermines the long-term reusability of models. Second, heritage owners and public contracting authorities have a strong interest in developing complementary organisational and technical measures—such as standardised copyright-related metadata schemes, explicit CDE policies and, in the longer term, IFC extensions or companion schemas, to ensure the continuity of copyright information throughout the lifecycle of HBIM models and potential heritage digital-twin implementations.

5.4. Implications for Heritage Conservation Practice

The findings indicate that the effective use of HBIM in heritage conservation requires the simultaneous management of both the technical and legal dimensions of the model. Otherwise, the model risks becoming a tool useful only during project delivery, losing its value as a long-term information resource supporting heritage management.

In particular, there is a need for a clear separation between rights relating to design libraries and rights relating to the integrated HBIM model, explicit regulation of the creation of derivative works, and the development of metadata standards capable of preserving information on authorship and licensing during IFC-based data exchange.

From a heritage conservation perspective, the absence of copyright-related information in IFC exports should be regarded not as a minor technical deficiency but as a significant systemic gap. The separation of a model from its legal context during data exchange creates a risk of unauthorized secondary use by subsequent designers or commercial entities, complicates the enforcement of rights in the event of disputes, and introduces uncertainty when models are disseminated as public data or open-access resources [65]. Consequently, HBIM projects are often forced to develop their own informal metadata and workflow practices, reducing opportunities for scalability and standardization.

To situate the Polish case study in a wider context, this section briefly refers to selected foreign approaches to BIM and copyright. In the United Kingdom, the work of the BIM Legal Working Group and the adoption of standardised BIM protocol clauses have contributed to clarifying issues of model ownership, authorship and liability, although fragmentation of rights between designers and clients remains a challenge. In the United States, the model contract provisions of the American Institute of Architects (AIA) on digital data and BIM address authorship, reuse and licensing of models within a predominantly contractual framework. In Australia and other common-law jurisdictions, BIM-specific contract clauses similarly focus on allocating ownership and reuse rights through detailed agreements. Compared with these examples, the Polish HBIM context is distinguished by the stronger role of inalienable moral rights and by public-law obligations concerning the protection of cultural heritage, which both constrain and shape possible contractual solutions.

The case study of the University of Wrocław Botanical Garden reflects this broader pattern. On the one hand, it demonstrates that an HBIM model can effectively support design and documentation processes even when developed within a CDE and exchanged via IFC. On the other hand, it exposes a common characteristic of Polish heritage conservation projects: a discrepancy between the declared role of the model as a long-term heritage management tool and its contractual treatment as merely part of the project documentation for a single investment undertaking.

The absence of precise provisions governing the transfer of rights to the integrated model, rights to derivative works, and metadata standards results in heritage-managing institutions possessing models of substantial technical value at project completion, yet with limited legal usability throughout the subsequent lifecycle of the asset.

6. Implications of the Research Findings for the Organization of HBIM Processes

For clarity, the recommendations proposed in this section are presented on two levels. First, short-term operational measures are identified, such as the inclusion of explicit copyright and licensing clauses in HBIM contracts, detailed BEP provisions and CDE policies, and the definition of standardised copyright-related metadata fields. Second, longer-term exploratory directions are outlined, including the application of blockchain-based provenance systems, persistent identifiers for heritage HBIM models and potential extensions of the IFC standard, which require further technical development and standardisation.

The synthesis of the results obtained from the legal-dogmatic analysis, the review of BIM/HBIM standards, and the case study makes it possible to identify a set of key recommendations for the organization of HBIM processes in heritage buildings, addressed to both public clients and design professionals. These recommendations concern both contractual arrangements and information management practices within the BIM environment. The most significant observations include:

- the need to treat the HBIM model as a strategic information asset with a long lifecycle rather than solely as the product of a single investment project,
- within procurement documentation and contractual agreements:
 - the need for unambiguous definitions of terms such as “project documentation” and “HBIM model,” including IFC exports and other forms of data exchange,
 - the importance of clearly defining the scope of economic copyright ownership of the integrated HBIM model and the rules governing the use of derivative works created during subsequent stages of the asset’s lifecycle,
 - the need to distinguish between intellectual property constituting the designer’s pre-existing assets (object libraries, templates, tools) and intellectual property relating specifically to the model developed for a particular heritage asset,
- the need to designate an entity responsible for maintaining the model throughout its lifecycle—a model curator (e.g., an investment department or cultural institution)—responsible for version control, integration of modifications, and supervision of data dissemination.

The analysis further demonstrated the importance of appropriately incorporating copyright-related issues into documents governing BIM processes, particularly the BIM Execution Plan (BEP). In this respect, the following aspects are of particular importance:

- identification of authors and rights holders for individual model components:
 - background IP (proprietary libraries, templates, tools)—retained by the designer,
 - project IP (the specific configuration of data within the HBIM model)—transferred or broadly licensed to the client,
- the use of standardized metadata concerning authorship, licensing, and permitted uses of the model,
- the definition of rules governing data access, downloading, and further dissemination within the Common Data Environment (CDE), particularly where open data or open-access publication of models is envisaged,
- preservation of authorship and licensing information throughout subsequent model updates.

The proposed organizational and contractual measures to mitigate the identified risks are summarized in Table 5.

Table 5. Organizational and contractual recommendations.

Area	Identified Problem in the Study	Recommended Action	Responsible Party
Tender documentation	Lack of provisions regarding rights to the HBIM model	Introduce requirements concerning ownership and licensing	Client
Contract	Vague provisions on transfer of rights	Clearly define copyright and reuse rights	Client/Designers
BEP (BIM Execution Plan)	No reference to legal aspects	Include a section on IP and data management	Designers/BIM Manager
CDE	Lack of access control and versioning	Implement access policies and audit mechanisms	CDE Operator
IFC/metadata	Loss of data during model exchange	Standardize data structures and validation	Designers/standardization organizations
Model reuse	Unclear conditions for reuse	Define reuse rules in contracts	Client/Designers
Archiving	Lack of long-term storage policy	Implement BIM archiving standards	Client/CDE Operator

The findings of the case study also highlight the limitations of current IFC-based data exchange mechanisms with respect to copyright-related information. Consequently, further development of organizational and technical solutions supporting intellectual property management within the HBIM environment appears justified, particularly by

- incorporating legal requirements into the BIM Execution Plan (BEP), including:
 - conventions for the identification and naming of authors and rights holders,
 - mandatory sets of copyright-related properties in native models and IFC files,
 - rules governing data access, downloading, and further dissemination within the CDE,
- enhancing CDE functionalities to enable:
 - logging and tracking of model download and sharing operations,
 - presentation and acceptance of licensing conditions prior to granting access to files,
- implementing consistent version-control policies that ensure the preservation of information regarding authorship, licensing, and modification history across successive model versions,
- developing an IFC profile dedicated to HBIM projects, including:
 - a dedicated set of properties for recording copyright-related information,
 - minimum requirements for identifying authors, rights holders, and licensing conditions,
- exploring the potential application of blockchain technologies and Persistent Identifier (PID) systems to trace model provenance and modification histories,
- conducting further empirical research into BIM/HBIM contractual arrangements and copyright management practices in heritage conservation projects in order to develop recommended contractual frameworks and best-practice guidelines.

7. Conclusions

The conducted research confirmed that Heritage Building Information Modelling (HBIM) models cannot be regarded solely as a digital form of project documentation but should instead be understood as complex information assets subject to copyright protection. This means that the legal status of HBIM models directly affects their further use, updating, and dissemination throughout the lifecycle of a heritage asset, while ambiguities in contractual provisions may lead to disputes and limit the usefulness of models as long-term digital twins.

Their distinctive nature results from the integration of geometric, historical, material, and conservation-related data, as well as from the multi-author character of their creation

process. Consequently, HBIM models should be perceived not only as design tools but also as long-term digital twins of heritage assets, whose legal status directly influences their continued use, modification, and dissemination.

The analysis of the applicable legal framework demonstrated that HBIM models generally meet the criteria for classification as works under Polish copyright law. At the same time, the interdisciplinary nature of HBIM projects means that, in most cases, such models constitute joint-authorship works whose exploitation and further development require a clear definition of the rights held by individual participants in the investment process. The findings indicate that statutory mechanisms governing joint authorship and the exercise of rights in derivative works are insufficient for the long-term management of cultural heritage resources. Accordingly, the contractual regulation of these issues is of critical importance.

Another significant outcome of the research is the identification of a discrepancy between the technical interoperability and legal interoperability of HBIM models. The analysis demonstrated that the open IFC standard effectively supports data exchange between different BIM environments; however, it currently lacks adequate mechanisms for preserving information relating to authorship, licensing conditions, and permitted uses of models. This creates a risk of losing the legal context during data exchange and limits the ability to manage intellectual property rights effectively throughout the model lifecycle.

The case study of the HBIM project developed for the historic greenhouse complex of the University of Wrocław Botanical Garden confirmed the occurrence of these issues in practice. Despite the use of a Common Data Environment (CDE) and IFC-based data exchange, the study identified a lack of clear regulations concerning model ownership, rights to future updates and procedures for preserving copyright-related information within metadata. These findings indicate that intellectual-property issues remain one of the least developed aspects of HBIM implementation in Poland.

These findings indicate that intellectual property issues remain one of the least developed aspects of HBIM implementation in Poland.

From the perspective of heritage conservation practice, the results suggest that public contracting authorities and heritage-management institutions should regard HBIM models as strategic information assets rather than merely as components of project documentation prepared for a specific investment undertaking. This requires securing a broad scope of economic rights to the integrated model, including the right to create derivative works and to update the HBIM model during future conservation projects, already at the stage of preparing procurement requirements and contractual arrangements. It also calls for the appointment of a model curator responsible for long-term maintenance, version control and supervision of model reuse.

The principal contribution of this article is the demonstration that the effective application of HBIM in heritage conservation requires the integration of technological, organisational and legal considerations. This entails treating copyright management as an integral component of BIM processes, encompassing procurement documentation, contractual agreements, the BIM Execution Plan (BEP), the Common Data Environment (CDE) and data-exchange procedures. The conceptualisation of HBIM as a complex joint-authorship work, combined with the diagnosis of the gap between technical and legal interoperability, provides a basis for developing more robust contractual and organisational models.

Future research should extend the analysis to solutions adopted in other legal systems and across different categories of HBIM projects. Such investigations would enable further refinement of the proposed conceptual framework and validation of the recommended contractual models. Particularly valuable directions include comparative

studies of approaches adopted in other European countries and in common-law jurisdictions (such as the United Kingdom, the United States and Australia), empirical investigations of a larger number of HBIM projects implemented in Poland and abroad, and research into IFC extensions or complementary metadata standards capable of ensuring the persistent preservation of copyright-related information. The development of such solutions may contribute to the creation of a more coherent and secure ecosystem for the digital management of cultural heritage.

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