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DATA CONTINUITY BETWEEN BIM AND GIS FOR SEAMLESS INTEGRATION OF OUTDOOR SPACES INTO DIGITAL TWINS: A CASE STUDY IN AUSTRIA

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Introduction

The climate crisis continues to intensify, as demonstrated by a variety of scientific studies. However, effective initiatives to mitigate its impacts are still lacking (Ripple et al., 2024). Even when regulations promoting urban greenery exist, authorities often lack the digital tools to verify whether permitted designs have been implemented in the built environment. Consequently, compliance with requirements for maintaining unsealed and green spaces remains low, resulting in inconsistent land use. This issue is particularly evident in urban areas, where rising temperatures and the heat island effect are worsened by sealed surfaces (Li et al., 2024). To address this, the AMAzE 2.0 project (FFG Die Österreichische Forschungsförderungsgesellschaft, 2025) was launched with the aim of optimising the use of outdoor and green spaces. A key part of this project involves regularly updating the built environment using overflight and satellite data to detect changes and enable targeted action by authorities. The basis for automated change detection is formed by the submitted documents from the building permit process. For this to be effective, 3D BIM models must be available that can be automatically verified. This requires collaboration between developers, planners, building authorities and surveying offices. A key issue is enabling targeted, lossless data exchange between BIM and geographic information systems (GIS) while complying with legal requirements and the data formats mandated by the authorities.

Methodology

The aim of the AMAzE 2.0 project is to develop an integrated system that automates the building permit process and the monitoring of outdoor spaces, using overflight and satellite data.

Two primary methodological approaches are used. Firstly, action research methodology was applied in the early development stages to identify key stakeholders and critical interface challenges. Workshops were then held with the identified key Stakeholders which helped to identify and group key issues into use cases, providing input for the project roadmap.

Secondly, a prototype was developed using a design science approach targeting real-world application within Austrian building and land surveying authorities. The prototype is continuously evaluated by the project's core team to ensure its technological relevance and practical feasibility.

BIM and GIS data exchange in AMAzE 2.0

For the digital submission process, the project builds on the findings of Urban et al. (2024), who examined the implementation of an openBIM-based digital permitting process in Vienna. This study extended their process, which covered the planning and permission phases, to include the construction and auditing phases. This extension shows the full building lifecycle (without deconstruction) and its outdoor spaces (see Fig. 1). In addition to the four phases, the process also highlights interactions with the property owner. These interactions are limited to notifying the owner if the submission complies with the law, and if, once construction is complete, something does not comply with the permission. To optimise monitoring, data needs to be stored in one place. Therefore, data transformation into the authority's GIS is required. As Urban et al. (2024) did not consider green spaces, additional references were considered, such as "Green BIM" (Knoll, 2023). While this project provides fundamental approaches for digital green space planning, it lacks focus on integration with official systems. Similarly, the study of Gao et al. (2020) examines BIM-GIS integration for integrated project delivery but does not offer applicable data exchange solutions. To address this, AMAzE 2.0 is developing a bidirectional ETL process using FME Workbench to enable the seamless exchange of data between BIM and GIS. Based on the regulatory framework in Austria, the approach follows that of Lam et al. (2024). This process also benefits planners, as it provides access to transformed geospatial data (e.g. digital terrain models) that serves as the basis for their planning and may be imported into the authoring software as a converted IFC-File.

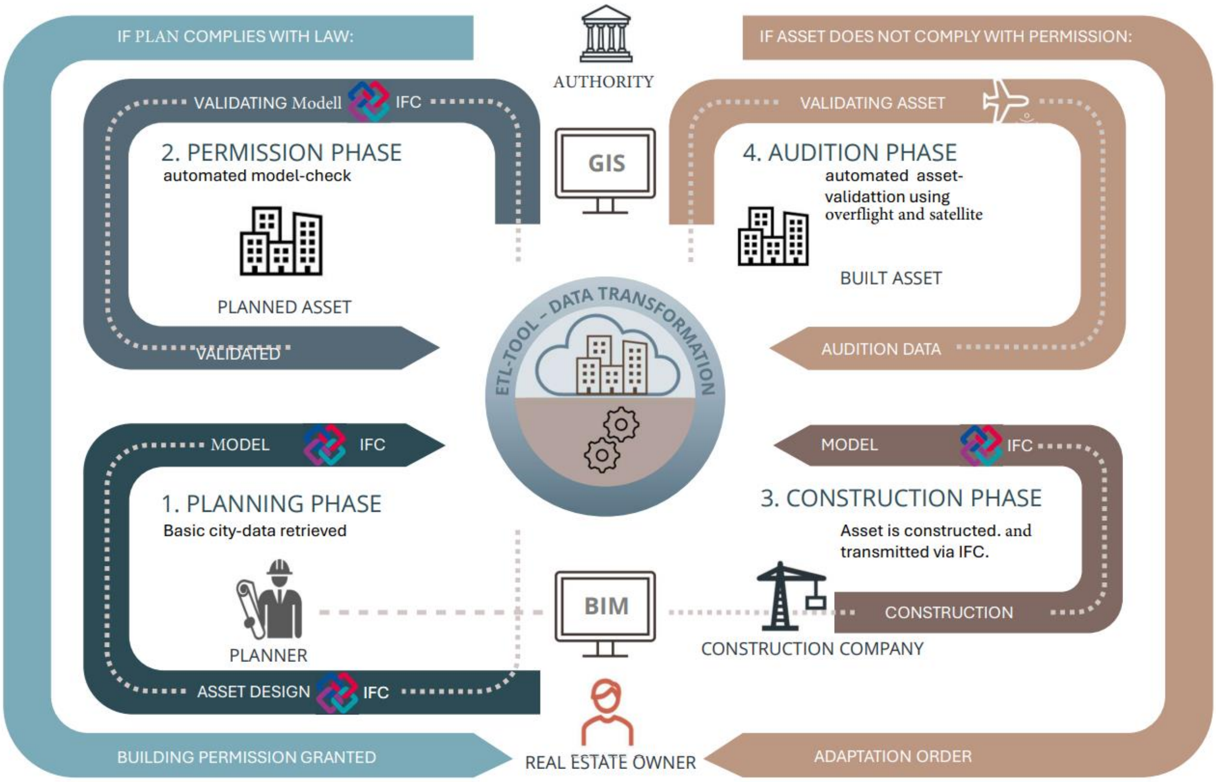

Figure 1: Lifecycle and Data Flow: from Planning to Audition Phase

Results

A key outcome of the development next to the AI-based green space monitoring tools (Petschnigg et al., 2024) is the BIM-GIS data exchange prototype. This system differs from previous attempts in three significant ways:

1. It is designed for full integration with official permitting workflows, supporting mandated formats such as GeoPackage, KMZ, and OBJ.
2. It includes all of the relevant green space types, including vertical greenery.
3. It implements the latest ISO-approved IFC schema (IFC 4.3).

Initial testing with datasets and BIM models of varying quality shows promising results. Findings indicate that improved quality of data exchange can be achieved, if planners have access to transformed planning data. However, the greatest improvement results from well-defined information requirements for BIM model submissions. This is feasible, as the necessary properties and geometries are already specified in the openBIM permit process's exchange information requirements.

Conclusion

The prototype aims to show that both planners and authorities can benefit from more efficient processes through the integration of BIM and GIS. The automated transformation of necessary planning documents from GIS to BIM improves the quality of the models, leading to a streamlined compliance check for authorities. The reverse transformation back to GIS enables automated monitoring of green spaces. This allows authorities to effectively combat the heat island effect.

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