

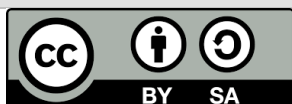
## Lecture 2 – BIM GIS integration – use cases

### Lecture Notes

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#### **Version**

Version 2.0

Date: April 2025

#### **Learning outcomes**

At the end of this lecture, the learner is expected to be able to

- Explain state of the art of the legislative on BIM GIS integration.
- Understand benefits gained from the use cases of the integration.
- Know the advantages and shortcomings of BIM GIS integration



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### ***Expected competences when entering the lecture***

**We assume that you, before taking this lecture, have**

- Basic knowledge about BIM fundamentals
- Basic knowledge about the GIS data

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## Revision history

| Revision | Date       | Author(s)             | Status                | Description  |
|----------|------------|-----------------------|-----------------------|--|
| 0.1      | 2023-09-06 | O. Bjelotomić Oršulić | Reviewed              | First version reviewed by Roderic, completely changed regarding comments in following versions |
| 0.2      | 2023-11-03 | O. Bjelotomić Oršulić | Draft                 | Table of Contents regarding Ariana's proposal of Table of Contents                             |
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| 0.4      | 2023-01-20 | O. Bjelotomić Oršulić | Draft                 | New version of the draft   |
| 1.0      | 2024-03-30 | O. Bjelotomić Oršulić | Version after reviews | New version  |
| 2.0      | 2025-04-29 | O. Bjelotomić Oršulić | Final                 | Updated EU logo and disclaimer. Edited by T. Näslund   |

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## 1 BIM-GIS integration use cases

### 1.1 BIM GIS integration in Planning Phase

Case study for the BIM-GIS integration in Planning Phase: Flood analysis to find the best location or structure of a facility/asset.

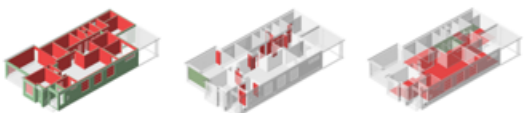
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### Integration in Planning phase - case study Flood analysis

Flood analysis to find the best location or structure of a facility/asset



Case study for a house in Maribyrnong: (a) study area, (b) flood simulation output in the area, (c) flood parameters around the house, (d) 3D visualisation of the inundation level for the house



3D Visualisation of Damaged Walls (left), Doors (middle) and Flooring (right) in ESRI ArcScene

Image web: <https://www.tandfonline.com/doi/abs/10.1080/14498596.2016.1189365>

By study presented in a paper: *A Data Model for Integrating GIS and BIM for Assessment and 3D Visualisation of Flood Damage to Building*, B. Veenendaal and A. Kealy (Eds.): *Research@Locate'15*, Brisbane, Australia, 10-12 March 2015, published at <http://ceur-ws.org> (URL 10)

A case study was conducted in collaboration with Maribyrnong Council and Melbourne Water. In this study, damage to a selected house in Maribyrnong was evaluated and visualized.

The BIM-GIS integration can facilitate a detailed assessment and 3D visualization of damage costs to a building that is presently not supported by the type of inputs used in the current methods for FDA.

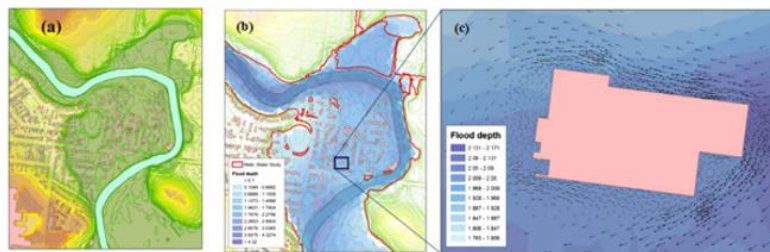
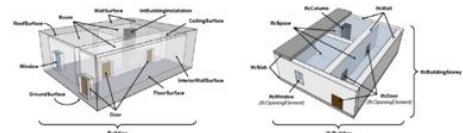
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### BIM-GIS integration in Planning phase

Assessment of flood damage to a building:

- using GIS and BIM data to plan and avoid flooding



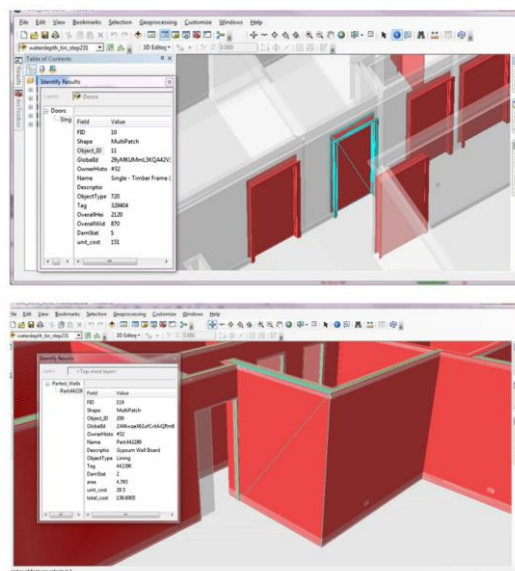
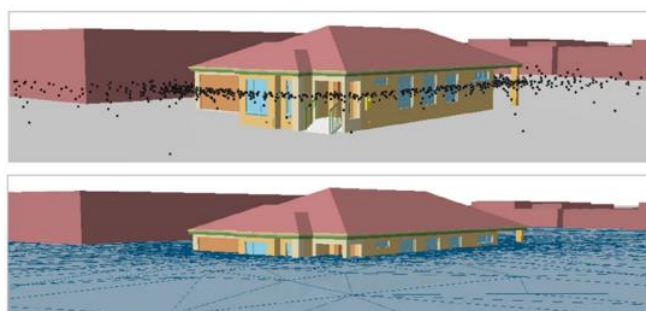
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### BIM-GIS integration in Planning phase

Results of such integration during planning phase:

successfully avoiding  
flooding area to build a  
house



Querying damaged assemblies using 'identify' tool in ArcScene for (top) doors and (bottom) wall linings([URL 10](#))

## 1.2 BIM GIS integration in urban planning and design process

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### BIM-GIS integration in urban planning and design process

BIM GIS integration significantly improve the design of more environmentally friendly urban environments

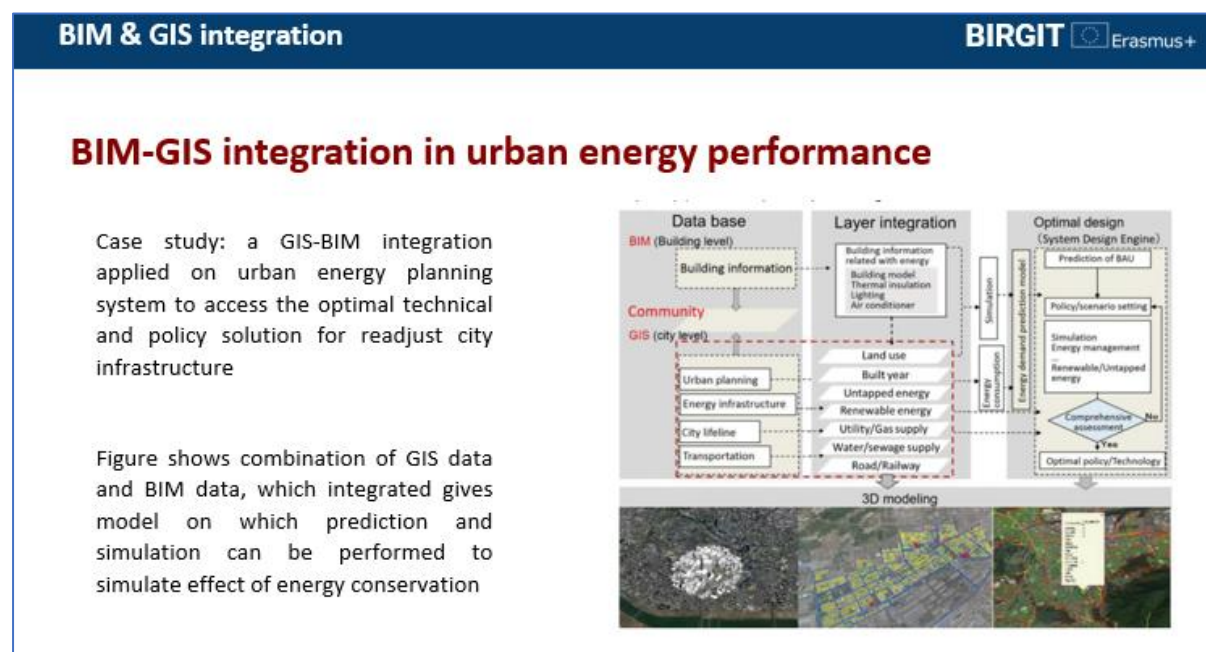
GIS supports decision making and policy making by enabling spatial analysis, data visualization, and scenario modeling, while BIM supports maintaining smart city infrastructure, including utilities, transportation, and public spaces. BIM allows for real-time monitoring and predictive maintenance, minimizing downtime and improving service delivery



Using BIM in urban planning and design process can significantly improve the design of more environmentally friendly urban environments. The BIM integration results with several advantages, including improved collaboration, increased efficiency, better visualization, cost savings, and sustainability. On the other hand, GIS in urban planning enables spatial analysis and modeling, which can contribute to a variety of important urban planning tasks. These tasks include site selection, land suitability analysis, land use and transport modeling, the identification of planning action areas, and impact assessments. GIS supports decision making and policy making by enabling spatial analysis, data visualization, and scenario modeling, while BIM supports maintaining smart city infrastructure, including utilities, transportation, and public spaces. BIM allows for real-time monitoring and predictive maintenance, minimizing downtime and improving service delivery.



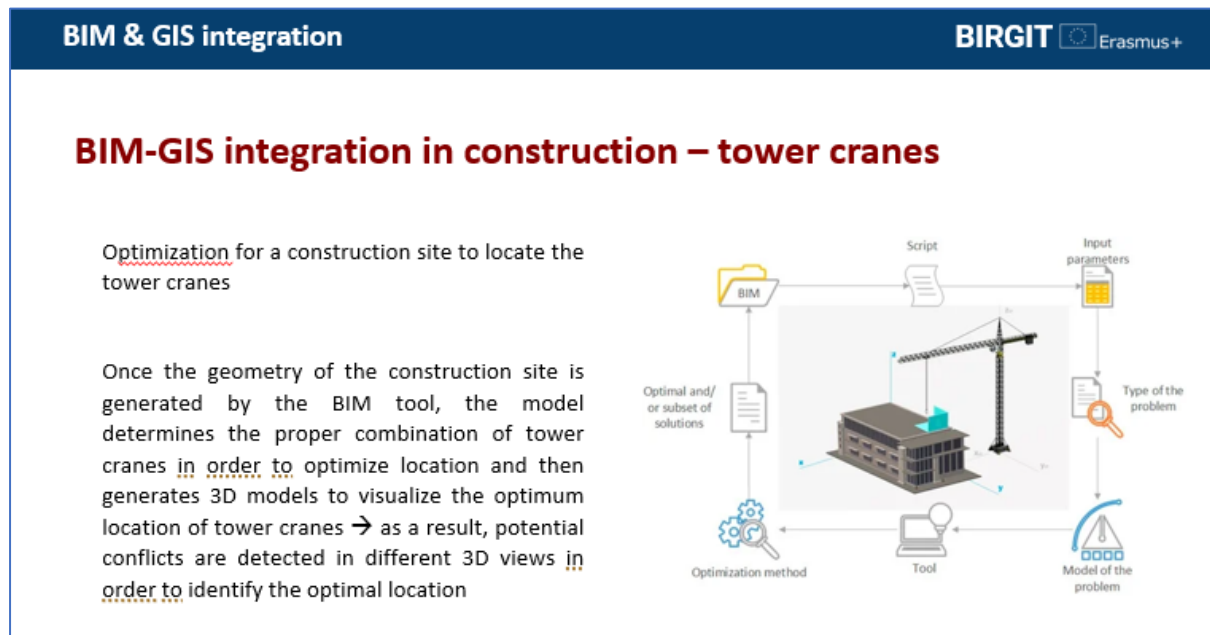
### 1.3 BIM GIS integration in assessment of urban energy performance



Based on study presented in: *BIM GIS integration in urban planning and design process*, Ihab HIJAZI, and Andreas DONAUBAUER, Kolbe 2017 and study ([URL 10](#)) *Assessment of Urban Energy Performance through Integration of BIM and GIS for Smart City Planning*, Shinji Yamamura, Liyang Fan, Yoshiyasu Suzuki, Procedia Engineering, 2017

A “GIS-BIM” based urban energy planning system to access the optimal technical and policy solution for readjust city infrastructure beyond the integrated analysis. The study suggested a GIS-Bim integration in order for urban energy planning tool which is able to propose the appropriate solutions for future smart city, considering urban development and infrastructure regeneration for future smart development. It works as a multi-functioned system that can (a) combine GIS based data and other data resources across the city, community and building; (b) model the city with layer integration; (c) predict and simulate the effect of energy conservation technologies in multi-scale by municipalities and developers; (d) visualize by 3D city modeling.

## 1.4 BIM GIS integration in construction – tower cranes



IRIZARRY et al. (2012) introduce a research for layout optimization for a construction site to locate the tower cranes. GIS were used to facilitate the analysis of spatial data used in the process of location optimization for tower cranes. Once the geometry of the construction site is generated by the BIM tool, the model determines the proper combination of tower cranes in order to optimize location and then generates 3D models to visualize the optimum location of tower cranes. As a result, potential conflicts are detected in different 3D views in order to identify the optimal location. The research was undertaken using a real world example.

Simulations in the geographic context of a building can also be applied during the detailed design phase. This might include energetic simulations involving shadowing effects by adjacent buildings, vegetation, or topography.

For urban planning and site selection, GIS data aids in location analysis. GIS is designed for spatial analysis, allowing users to perform tasks like site suitability analysis, proximity analysis, and spatial. These capabilities can inform decisions related to site selection, environmental impact assessments, and land use planning, providing valuable input for the early stages of design. GIS can also assist in site analysis for construction projects, considering factors like slope, soil type, drainage, and environmental conditions. By integrating GIS data into the BIM process, architects and engineers can make more informed decisions about building design and construction methods.

## 1.5 BIM GIS integration in traffic simulations

BIM GIS integration is explained on use case of traffic simulation in Paris.

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### BIM-GIS integration in traffic simulations

Use case: traffic simulation in Paris

Integration opens possibility to analyse the impact of restricting access to a road, constraining movement in a single direction, or introducing an intersection


A 3D design model can simulate dynamic changes and their implications, facilitating stakeholder buy-in during the decision-making process



The integration of BIM and GIS in traffic simulations opens up intriguing possibilities. Consider the impact of restricting access to a road, constraining movement in a single direction, or introducing an intersection. The analytical outcomes presented within a 3D design model prove invaluable in effectively communicating the implications of such changes, facilitating stakeholder buy-in during the decision-making process. Traffic simulation in Paris, [video](#).

BIM GIS integration is explained on use case of simulating pedestrian zones.

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### BIM-GIS integration in traffic simulations

Use case: pedestrian zones

Integration opens possibility to analyse the impact of restricting access to a road, constraining movement in a single direction, or introducing an intersection

A 3D design model can simulate dynamic changes and their implications, facilitating stakeholder buy-in during the decision-making process





Image web: <https://www.bimcommunity.com/news/load/382/beneficios-y-complejidades-del-gis-y-el-bim>

Also, BIM GIS Integration has its usage in the microsimulation of pedestrian traffic in a large park which involves the detailed analysis and modeling of individual pedestrian movements within the park environment. This simulation method accounts for various factors such as pedestrian behavior, paths, and interactions, providing a granular understanding of how individuals navigate and utilize the park space. GIS data includes information about terrain, topography, and environmental features. By integrating this data with BIM, the microsimulation can account for the influence of the physical environment on pedestrian traffic patterns, considering factors like slopes, vegetation, and other landscape elements. Furthermore, the BIM GIS integration enables the simulation of dynamic scenarios, such as changes in pathways, addition of amenities, or alterations to the park layout. This allows planners to assess the impact of design modifications on pedestrian flows and optimize the park infrastructure accordingly. This example of integration reaches even planners which can analyze real-world data related to pedestrian behavior and movement, improving the accuracy of the microsimulation results and leading to more informed design choices, closing the whole planning phase of the project with the possible outcomes and influence on different related subjects.

## 2 Legislative for BIM GIS integration

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### BIM-GIS integration – EU’s direction for the future

the EU has been promoting the use of BIM and GIS technologies in various ways to improve infrastructure planning, construction, and management.

There are directives and regulations related to data sharing, interoperability, and open standards that indirectly influence the integration of BIM and GIS.

Various EU initiatives and policies indirectly support the adoption and integration of these technologies.

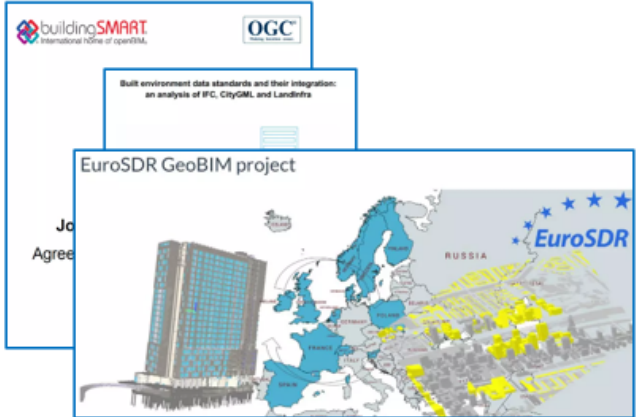


Image credit: Shanghee Shin, web url: <https://www.slideshare.net/endofcap/integration-of-bim-and-gis-from-ideal-to-reality>

Although it is not yet fully supported by the legislative, BIM-GIS integration is gaining momentum.


The EU has been promoting the use of BIM and GIS technologies in various ways to improve infrastructure planning, construction, and management.

The European Commission has supported initiatives aimed at advancing digitalization in the construction sector, which often includes promoting the use of BIM technologies, such as Building SMART and EuroSDR GeoBIM project. Additionally, there are directives and regulations related to data sharing, interoperability, and open standards that indirectly influence the integration of BIM and GIS.

While there may not be a specific legislative directive focused solely on BIM-GIS integration, various EU initiatives and policies indirectly support the adoption and integration of these technologies, although individual EU member states may have their own regulations or guidelines regarding the use of BIM and GIS in construction projects. These can vary in scope and implementation.

### 3 Priceless advantages of BIM GIS integration

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**„Priceless” advantages of BIM-GIS integration**

- ✓ **Enhanced Decision-Making**
- ✓ **Improved Collaboration**
- ✓ **Data Consistency**
- ✓ **Asset Lifecycle Management**
- ✓ **Sustainability**

The integration of Building Information Modeling (BIM) and Geographic Information Systems (GIS) offers numerous advantages for infrastructure planning, construction, and management.

By combining BIM's detailed building data with GIS's spatial analysis capabilities, stakeholders gain a comprehensive understanding of both the physical and locational aspects of projects.

This integration facilitates improved decision-making throughout the project lifecycle, from initial planning to maintenance and renovation.


BIM GIS integration enhances collaboration among multidisciplinary teams by providing a unified platform for sharing and visualizing data, leading to increased efficiency, reduced errors, and better-informed decision-making.

Additionally, it enables stakeholders to assess the impact of proposed designs on the surrounding environment, infrastructure, and communities, promoting sustainable development practices.



## 4 Addressing the challenges of BIM and GIS integration

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**Remained challenges for the BIM GIS integration still a head of us**

- Data Compatibility
- Data Quality
- Coordination and Collaboration
- Standards and Interoperability
- Data Volume and Complexity
- Data Updating and Maintenance
- Integration Tools and Software
- Privacy and Security
- Training and Expertise
- Costs
- Change Management
- Legal and Licensing Issues
- ...

Integrating BIM and GIS can be a complex process, and several challenges and issues may arise during the integration. These issues can impact the efficiency, accuracy, and effectiveness of the integration effort. Here are some of the main issues regarding BIM and GIS integration:

1. **Data Compatibility:** BIM and GIS data formats are often not directly compatible. BIM data may use specific proprietary formats, while GIS data uses various spatial data formats (e.g., shapefiles, GeoJSON). Converting and harmonizing data between these formats can be challenging.
2. **Data Quality:** Ensuring the accuracy and quality of both BIM and GIS data is critical for successful integration. Inaccurate or incomplete data can lead to errors and misinterpretations during the integration process.
3. **Coordination and Collaboration:** Effective coordination and collaboration among different stakeholders, including architects, engineers, GIS specialists, and facility managers, are essential. Miscommunication or lack of collaboration can hinder the integration process.
4. **Standards and Interoperability:** The lack of universally accepted standards for BIM and GIS integration can be a significant challenge. While standards like Industry Foundation Classes (IFC) exist for BIM, achieving seamless interoperability with GIS standards can require additional effort.

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5. **Data Volume and Complexity:** BIM models can be large and complex, particularly for large-scale infrastructure projects. Handling and processing such massive datasets within GIS environments can strain resources and slow down workflows.
6. **Data Updating and Maintenance:** Keeping both BIM and GIS data up-to-date and synchronized over the entire lifecycle of a project or facility can be challenging. Changes made in one system need to be reflected in the other in a timely and accurate manner.
7. **Integration Tools and Software:** Choosing the right software tools and solutions for BIM and GIS integration can be difficult. Some integration solutions may require custom development or scripting to bridge the gap between the two systems.
8. **Privacy and Security:** Handling sensitive information related to buildings, infrastructure, and facilities requires strict privacy and security measures. Integrating data while maintaining data security can be complex.
9. **Costs:** Implementing BIM and GIS integration can involve significant costs, including software licensing, hardware upgrades, data conversion, and staff training. Organizations need to carefully assess the return on investment.