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Lecture 2 – BIM GIS integration - overview

Lecture Notes

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License

Version

Version 2.0

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Learning outcomes

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

- Explain the basic concept and main properties of BIM GIS integration.
- Understand different scale of BIM and GIS.
- Know particular properties of BIM and GIS..

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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
0.3	2023-12-14	O. Bjelotomić Oršulić	Draft	New version of the draft
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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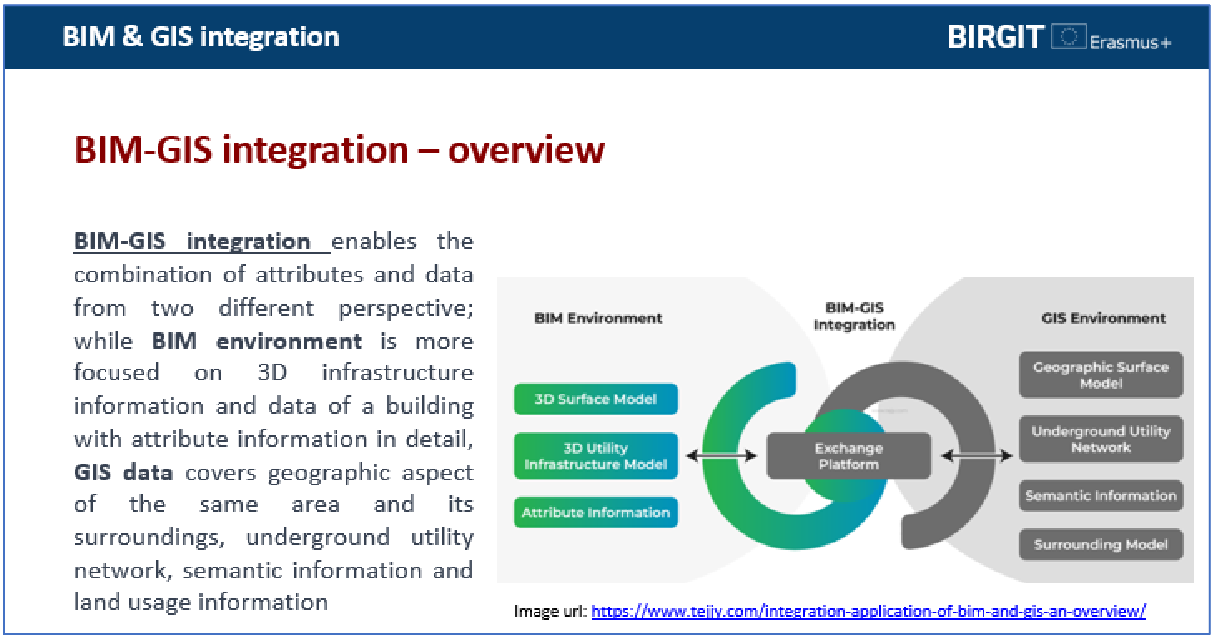
1 BIM-GIS integration – overview



The life-cycle stages, namely planning, design, construction, maintenance, and decommissioning, constitute pivotal elements in the domain of any significant construction or infrastructure project.

Using Building Information Modeling (BIM) carefully helps prevent losing or decreasing the value of data when moving between different project phases. BIM, when appropriately executed, facilitates the seamless and versatile utilization of data across the entire life-cycle, thereby mitigating redundancy and loss. The integration of Geographic Information System (GIS) with BIM emerges as a synergistic approach, augmenting the comprehensiveness of data management by incorporating spatial information.

This integration enriches the contextual understanding of the built environment and also affords a more holistic and informed decision-making process throughout the life-cycle of the building. BIM-GIS integration enables the combination of attributes and data from two different perspective; while BIM environment is more focused on 3D infrastructure information and data of a building with attribute information in detail, GIS data covers geographic aspect of the same area and its surroundings, underground utility network, semantic information and land usage information, as shown in the Figure 1.

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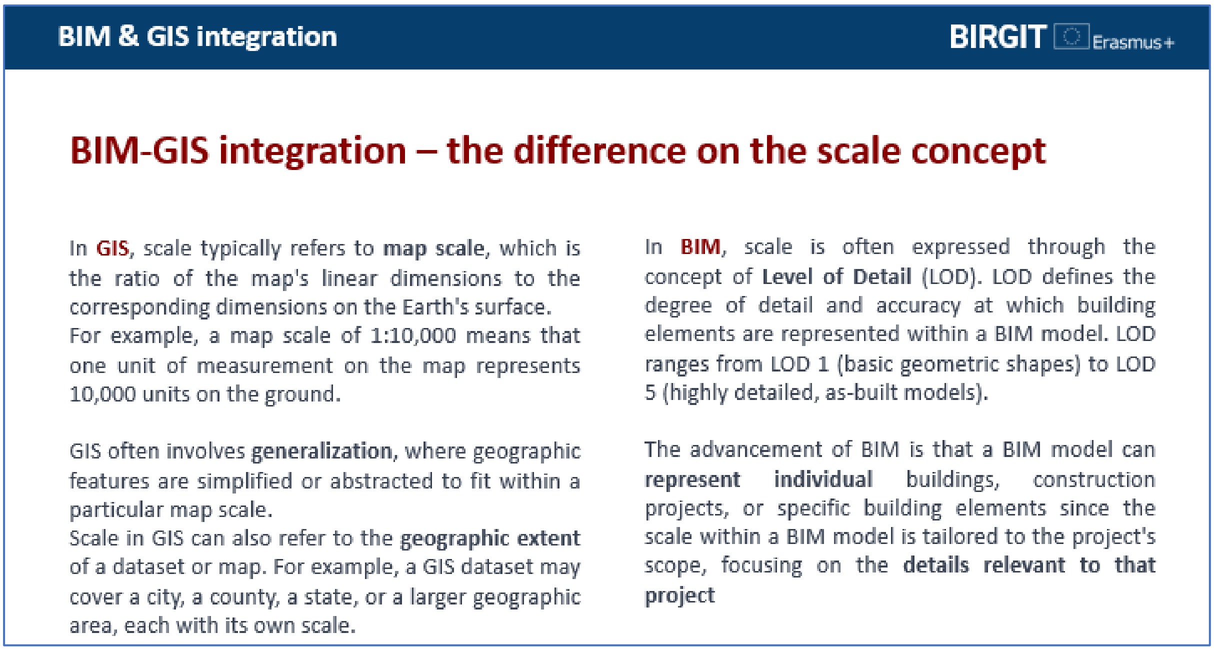
1.1 Scale in BIM vs SCALE in GIS



Scale in both Building Information Modeling (BIM) and Geographic Information Systems (GIS) refers to the representation of real-world objects and features at different levels of detail or precision, relative to the Earth's surface or the built environment. However, the way scale is applied and understood differs between these two technologies.

The thing that differs significantly these two technologies is its scale. In GIS, scale typically refers to map scale, which is the ratio of the map's linear dimensions to the corresponding dimensions on the Earth's surface. For example, a map scale of 1:10,000 means that one unit of measurement on the map represents 10,000 units on the ground. GIS often involves generalization, where geographic features are simplified or abstracted to fit within a particular map scale. This process ensures that maps remain legible and manageable at different zoom levels. Scale in GIS can also refer to the geographic extent of a dataset or map. For example, a GIS dataset may cover a city, a county, a state, or a larger geographic area, each with its own scale. Also, in GIS, spatial data can have varying levels of resolution, which impacts the level of detail and precision in the representation of geographic features. Higher-resolution data provides more detail but may require more storage and processing resources.

In BIM, scale is often expressed through the concept of Level of Detail (LOD). LOD defines the degree of detail and accuracy at which building elements are represented within a BIM model. LOD ranges

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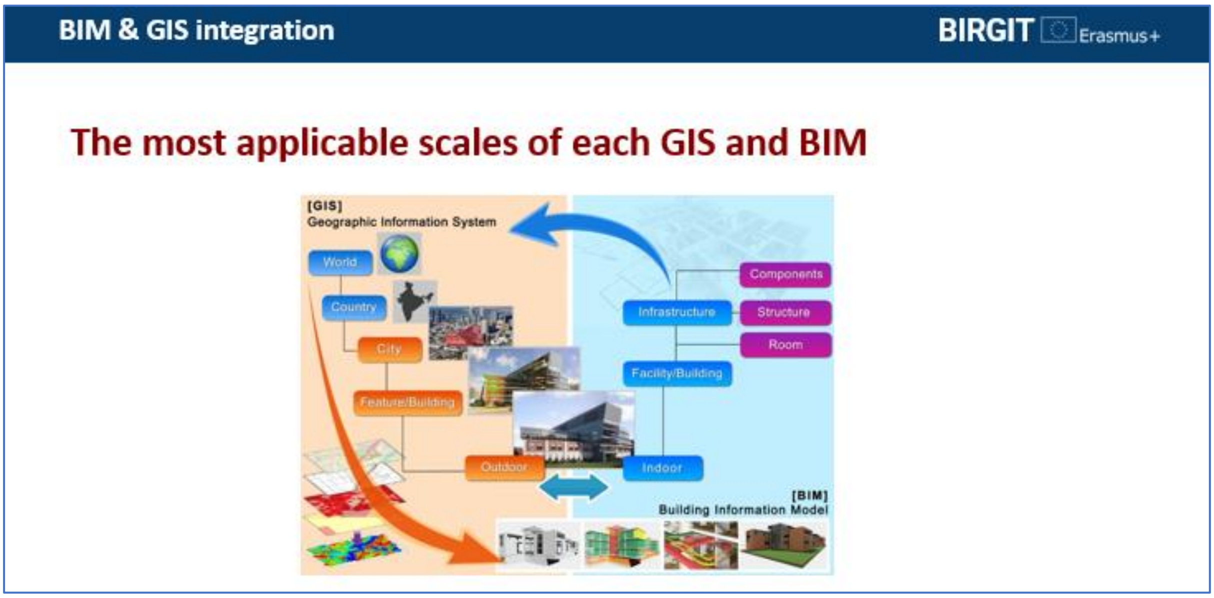
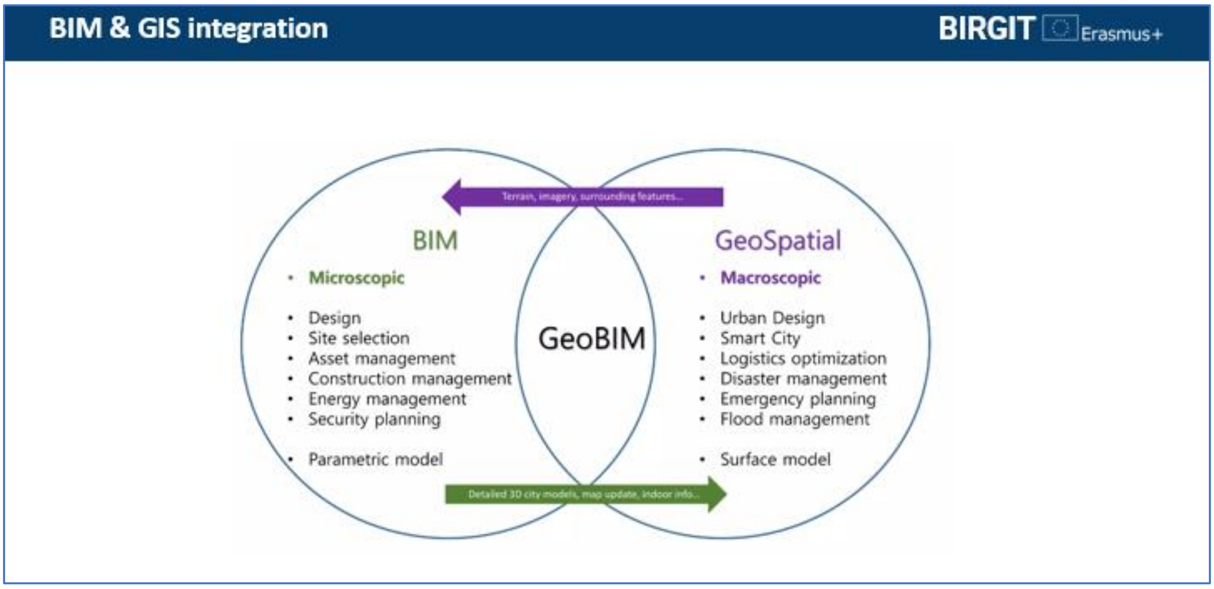
from LOD 1 (basic geometric shapes) to LOD 5 (highly detailed, as-built models). The choice of LOD depends on the project phase and requirements. Since the scale in BIM is used to balance the level of geometric detail with the precision needed for design, construction, or facility management tasks, higher LODs represent elements with greater geometric accuracy, but they also require more data and computational resources. The advancement of BIM is that a BIM model can represent individual buildings, construction projects, or specific building elements since the scale within a BIM model is tailored to the project's scope, focusing on the details relevant to that project.



The most applicable scales of each GIS and BIM are given in Figure 2. In BIM, scale relates to the level of detail and accuracy within a building or construction project, whereas in GIS, scale primarily refers to map scale and the generalization of geographic data for cartographic representation. The choice of scale in both technologies depends on the specific objectives and requirements of the project or application.



From a microscopic perspective BIM focuses on detailed information about individual building components and systems, such as walls, floors, and utilities. Through the comprehensive digital representation of entire buildings or infrastructure projects, BIM model facilitating helps ensure accurate construction and maintenance and provides efficient collaboration and decision-making among stakeholders throughout the project lifecycle.

From a macroscopic perspective Geographic Information Systems (GIS) are like digital maps that store, analyze, and visualize geographic data. They help professionals understand and manage spatial information about land, infrastructure, and resources. GIS excels in its capacity to analyze large-scale geographic data sets and spatial relationships across vast areas, enabling strategic planning, decision-making, and management of expansive landscapes, regions, or urban environments with broad spatial considerations.

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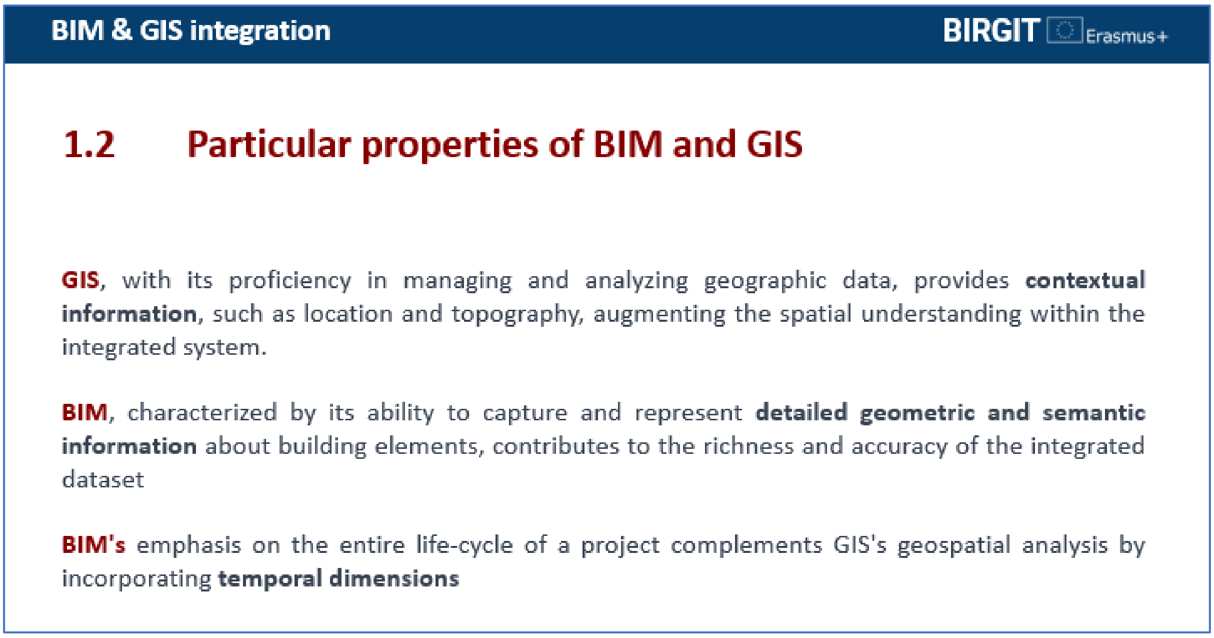
1.2 Particular properties of BIM and GIS



The distinctive properties of BIM and GIS play crucial roles in enhancing their integration. BIM, characterized by its ability to capture and represent detailed geometric and semantic information about building elements, contributes to the richness and accuracy of the integrated dataset.

BIM's focus on the physical and functional aspects of infrastructure aligns with GIS's spatial analysis capabilities. GIS, with its proficiency in managing and analyzing geographic data, provides contextual information, such as location and topography, augmenting the spatial understanding within the integrated system.

BIM's emphasis on the entire life-cycle of a project complements GIS's geospatial analysis by incorporating temporal dimensions. This synergy results in a comprehensive dataset that combines detailed building information with spatial context, fostering a more holistic approach to facility and infrastructure management.

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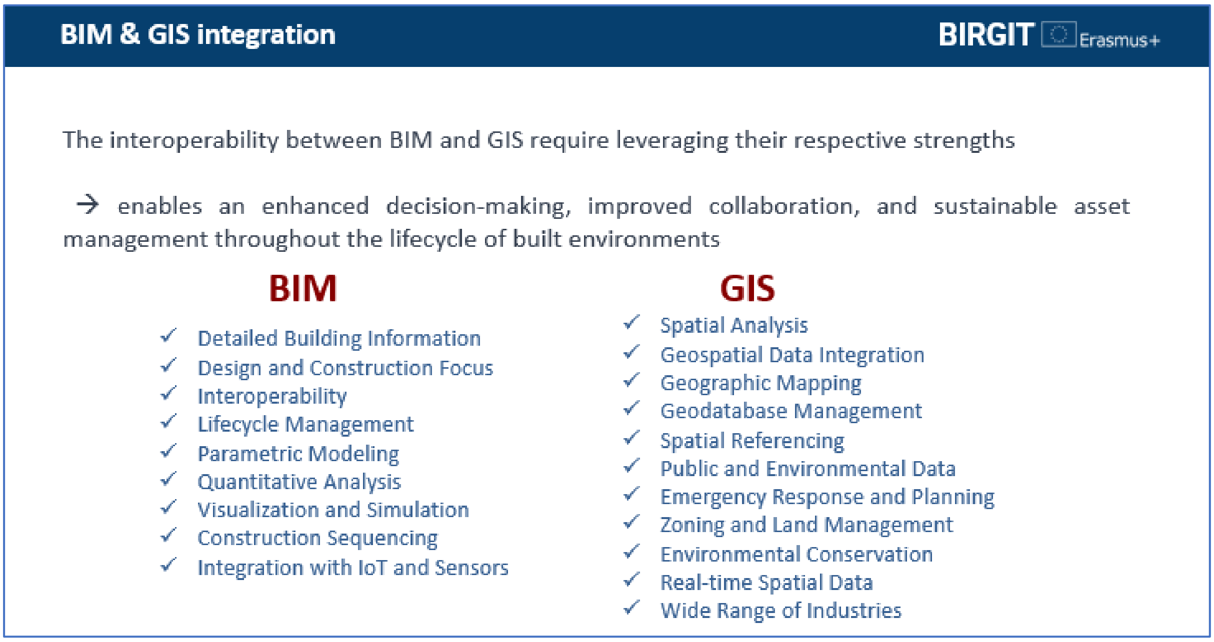

The interoperability between BIM and GIS, leveraging their respective strengths (given in Figure 3), enables an enhanced decision-making, improved collaboration, and sustainable asset management throughout the lifecycle of built environments. On each side, the strengths of BIM and GIS are given, respectively.

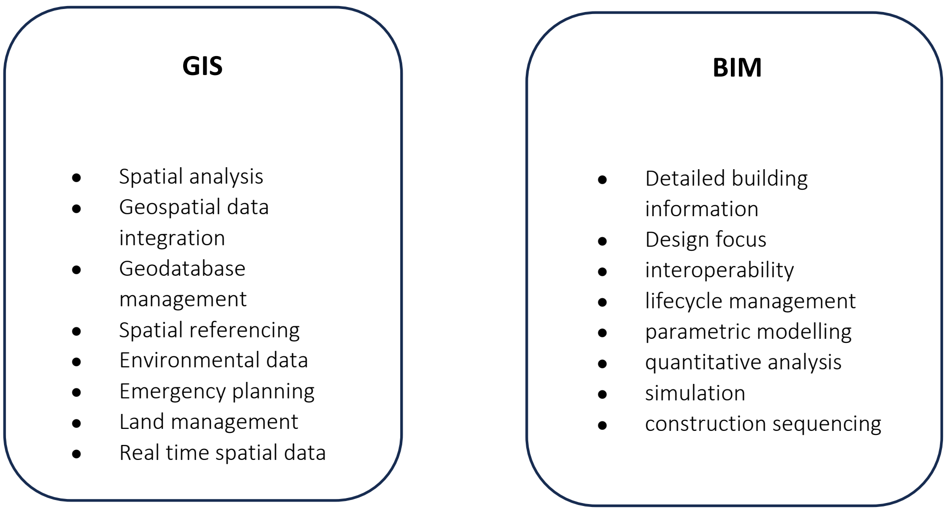

Figure 1 Particular strenghts of BIM and GIS

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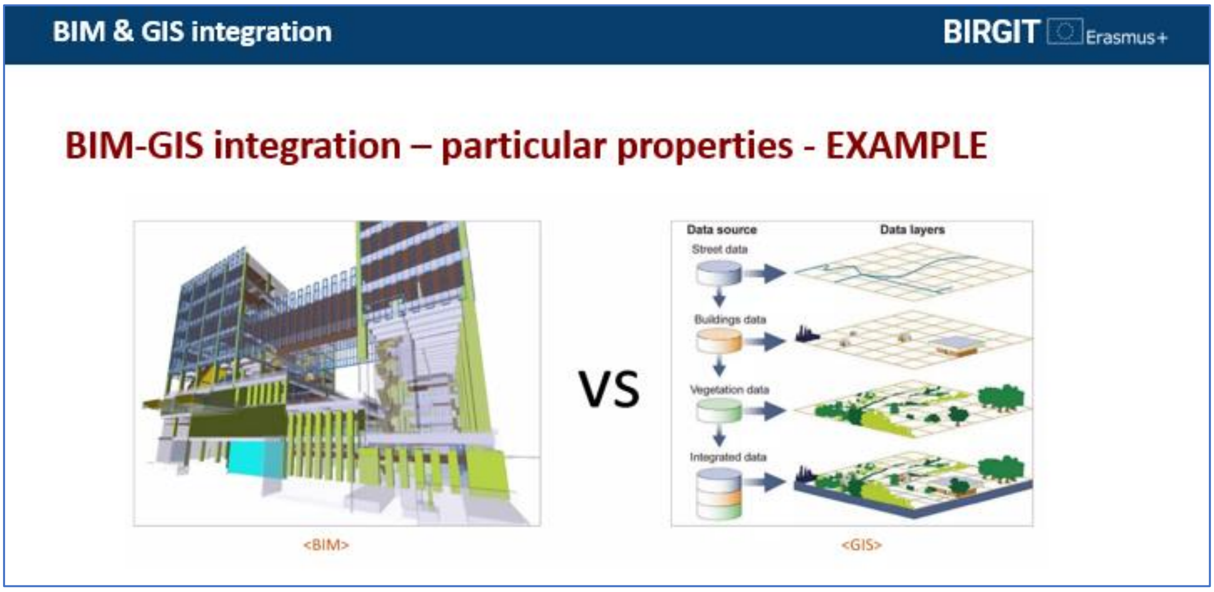

This example shows particular properties of the BIM model on the left side and of the GIS model on the right side.

Particularity of the BIM model is that exists before the final entity, it is imagined construction of the building before construction, while the GIS represents and existing entity of the building's surroundings, such as vegetation data, neighboring buildings data, street data etc.

The BIM model comprehends maximum LOD in geometric representation, while the GIS model consists of multiple LOD.

While the BIM model mainly focus on buildings, structures, components in a limited area of a building that is modeling, a GIS model usually focus on a data that represents outdoor space around the building BIM model is referring to.

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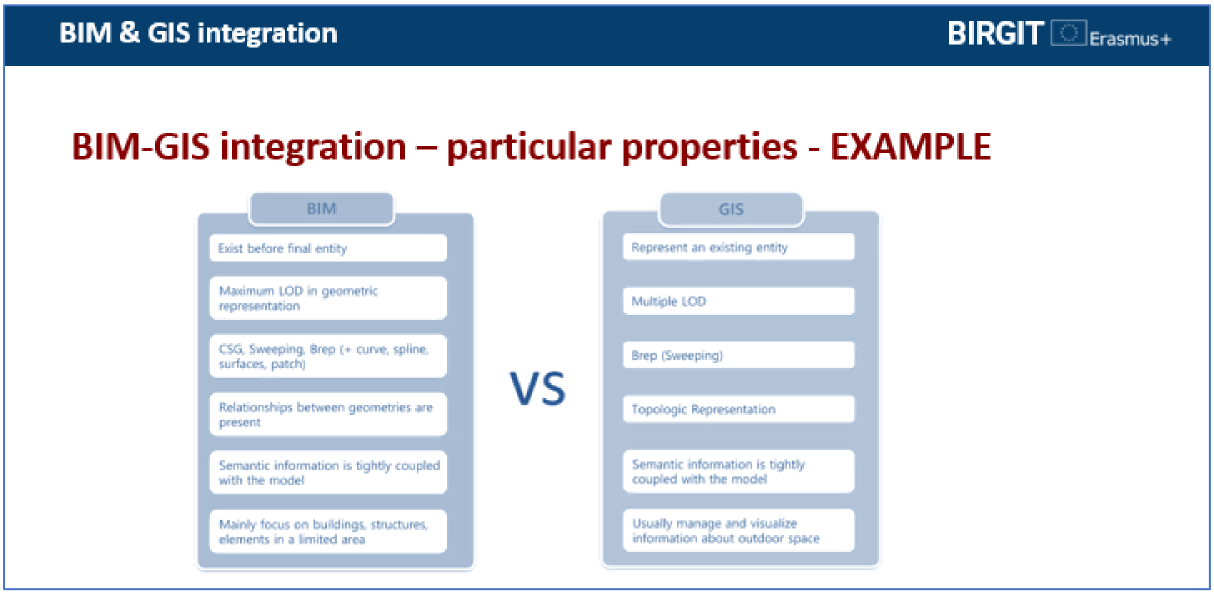

In this slide, more detailed comparison of a particular properties of BIM and GIS is shown, respectively, highlighting the opposite strengths of particular properties in BIM and GIS data that are enhance the data manipulation through the BIM GIS integrated approach.