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BIRGIT – training on Building InfoRmation models integrated with Geographical InformaTion

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Lecture 2.2 – BIM GIS integration in projects' life cycle

Lecture Notes

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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 different project's stages in which BIM GIS integration can be applied
- Understand the benefits of integration for different stakeholders
- Know which benefits integration can provide in each stage of project's life cycle

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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
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2.0	2025-04-29	O. Bjelotomić Oršulić	Final	Updated EU logo and disclaimer. Edited by T. Näslund

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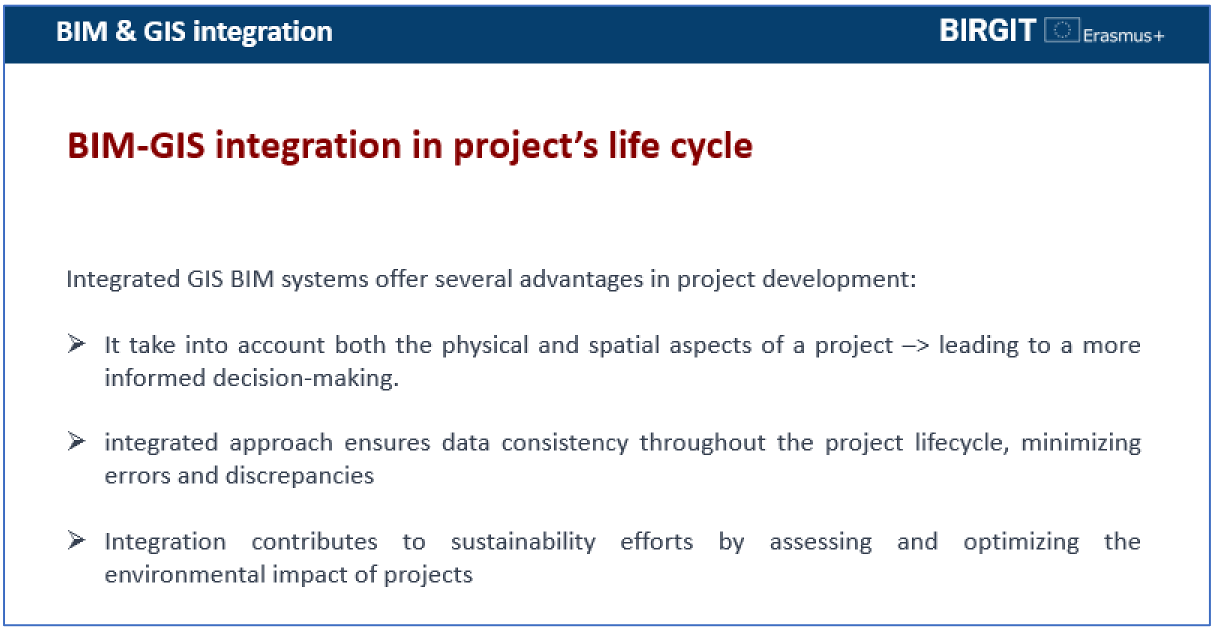
Contents

1 Application of BIM GIS integration in Project's Life Cycle



Integrated GIS BIM systems offer several advantages in project development. They contribute to more informed decision-making by taking into account both the physical and spatial aspects of a project. This comprehensive understanding engage stakeholders to make strategic choices that align with project goals.

Integration fosters collaboration among diverse teams, including architects, engineers, urban planners, and GIS specialists. This collaborative synergy supports and can enhance a project workflows, making them more efficient and streamlined.

Also, the integrated approach ensures data consistency throughout the project lifecycle, minimizing errors and discrepancies. This reliability in data contributes to the overall accuracy of project outcomes which support better asset lifecycle management. The integration of BIM and GIS on a project contributes to sustainability efforts by assessing and optimizing the environmental impact of projects. By considering both building design and its relationship to the surrounding environment, these integrated solutions promote more environmentally conscious project development practices.

The examples of BIM GIS integration are divided in several main applications; planning phase, construction, facility management and sustainability in following text.

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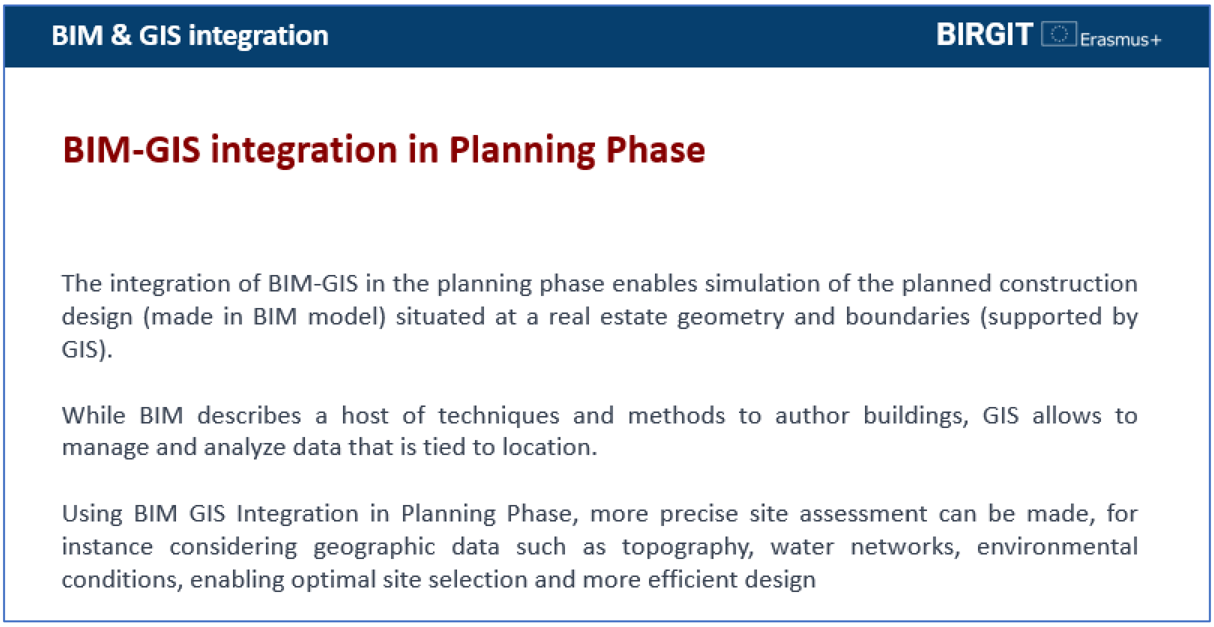
1.1 BIM-GIS in Planning Phase



Planning phase in construction is a crucial stage that lays the foundation for the successful execution of a construction project. Proper planning helps ensure that the project is completed on time, within budget, and meets the required boundary conditions, design layout and quality standards.

The integration of BIM-GIS in the planning phase enables simulation of the planned construction design (made in BIM model) situated at a real estate geometry and boundaries (supported by GIS). Within this context, use of BIM models gives a new perspective by representing an input for simulation and analysis task (Mattern, Konig (URL 3)).

BIM and GIS are the two most popular technologies in the built environment. While BIM describes a host of techniques and methods to author buildings, GIS allows to manage and analyze data that is tied to location. In the planning phase, a BIM 3D model of the building can be generated holding information about the structure and components of the building. Once created, BIM enables faster design updates to buildings through an integrated design environment (not depending of a software). The BIM process allows for better coordination between different teams contributing to a project – architects, engineers and contractors can work seamlessly together using this system because it provides detailed representation of the building for all interested parties, i.e. professionals.

The Integration of GIS and BIM proves advantageous for architecture and planning across various project stages, including the pre-construction phase. Through the seamless integration of GIS and BIM,

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enhancements in efficiency, quality, sustainability, and mitigation of environmental impact can be achieved.

However, GIS and BIM integration is still challenging. Many projects fail to take advantage of this technology because the tools and processes are not fully integrated. The most common cause of this failure is that GIS and BIM are used separately rather than together. This can be due to project limitations on budget or time frame or simply because a project team doesn't understand how these technologies work together (URL 3).

To overcome the challenges of BIM and GIS integration in Planning Phase, different stakeholders have to collaborate, for example an architect should create a 3D model containing information like building geometry and other attributes such as room dimensions or lighting fixtures. This could then be linked up with a plan view of the site using GIS tools, which would allow them to visualize how things fit together before construction takes place.

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Using BIM GIS Integration in Planning Phase, more precise site assessment can be made, for instance considering geographic data such as topography, water networks, environmental conditions, enabling optimal site selection and more efficient design ([URL 4]).

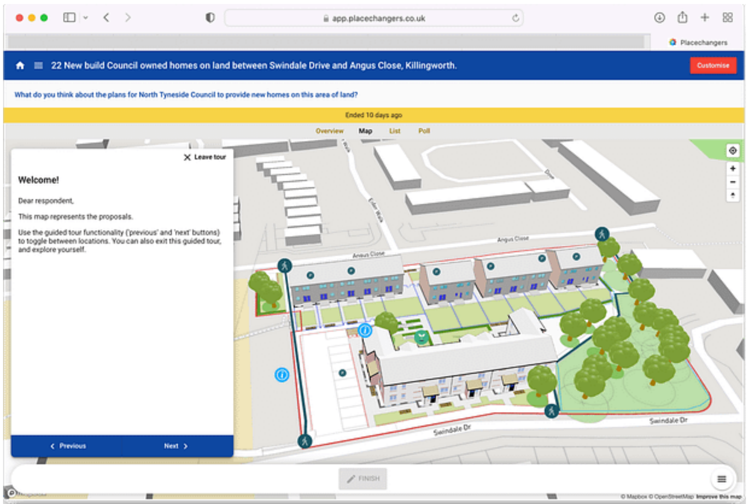

Figure 1 example of integration of BIM and GIS in a Planning Phase ([URL 4])

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In the planning phase, choosing the right site is a fundamental step for the success of any construction project. BIM-GIS integration allows a much more precise and comprehensive site assessment. Incorporating geographical data, encompassing factors like terrain conditions, topography, and accessibility, into BIM models is a seamless process. This enables to swiftly and efficiently examine various scenarios, assessing the implications of diverse variables in the planning and design phases of a project. This assists in selecting the optimal site, considering both problems and opportunities offered by the geographical location.

Figure 2 Choosing the right site for the planned building integrating the BIM with GIS in the planning phase(URL 5)

During the design phase, the integrated BIM-GIS approach offers deep integration between spatial information and project details working with geospatial data in real-time while designing buildings or infrastructure. According to (URL 5), there are few key applications in planning phase:

1. Precise Environmental Analysis: Integration with geographic data allows precise evaluation of the surrounding environment, including aspects like sun exposure, prevailing winds, and vegetation. This information is crucial for designing environmentally sustainable buildings.

2. Water Resource Management: GIS data can provide detailed information on water resource availability and water management. This is crucial for designing effective drainage systems and flood prevention.

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3. Transport and Accessibility Analysis: Access to transport infrastructure is a critical factor in urban planning. BIM-GIS integration allows assessment of accessibility and traffic impact, contributing to planning more efficient roads, parking, and public transport systems.

4. Environmental Impact Analysis: During design, it's essential to consider the project's environmental impact. Using GIS data helps evaluate how the project might affect surrounding fauna, flora, and ecosystems, aiding in informed decisions for environmental conservation.

5. Resource Management: Planning sustainable projects requires accurate resource management. BIM-GIS integration facilitates the planning and efficient utilization of resources like energy and construction materials.

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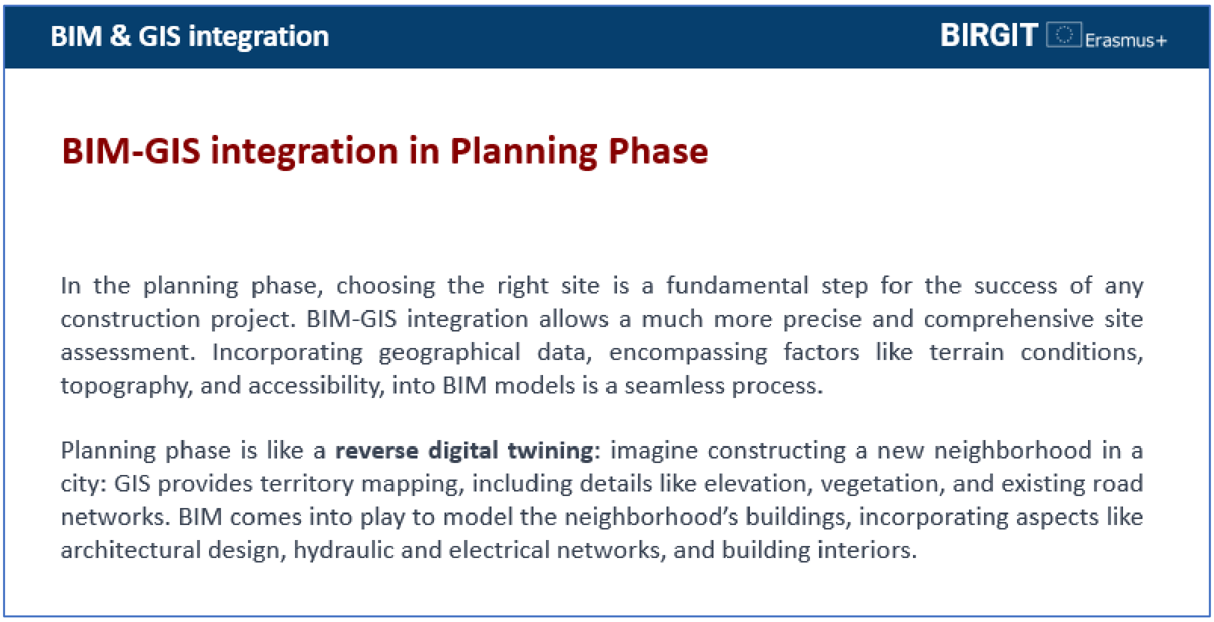
Another important benefit of usage of BIM GIS integration during a planning phase is a possibility for all the stakeholder to collaborate on a single platform, which is nowadays mostly offered by producers of a most common software's used in a BIM GIS communication (link to the section where the software are mentioned in detail).



Planning phase is like a reverse digital twining: imagine constructing a new neighborhood in a city: GIS provides territory mapping, including details like elevation, vegetation, and existing road networks. BIM comes into play to model the neighborhood's buildings, incorporating aspects like architectural design, hydraulic and electrical networks, and building interiors. The model obtained from a BIM and GIS integration is a geospatial digital twin: digital representation that combines geographical context with structural and functional details of buildings. For instance, in urban renewal projects or detailed urban planning, a geospatial digital twin can demonstrate how new buildings will influence traffic flow, street lighting, or water supply networks. Using this technology allows simulating different scenarios before undertaking actual interventions, enabling more informed and sustainable decisions.

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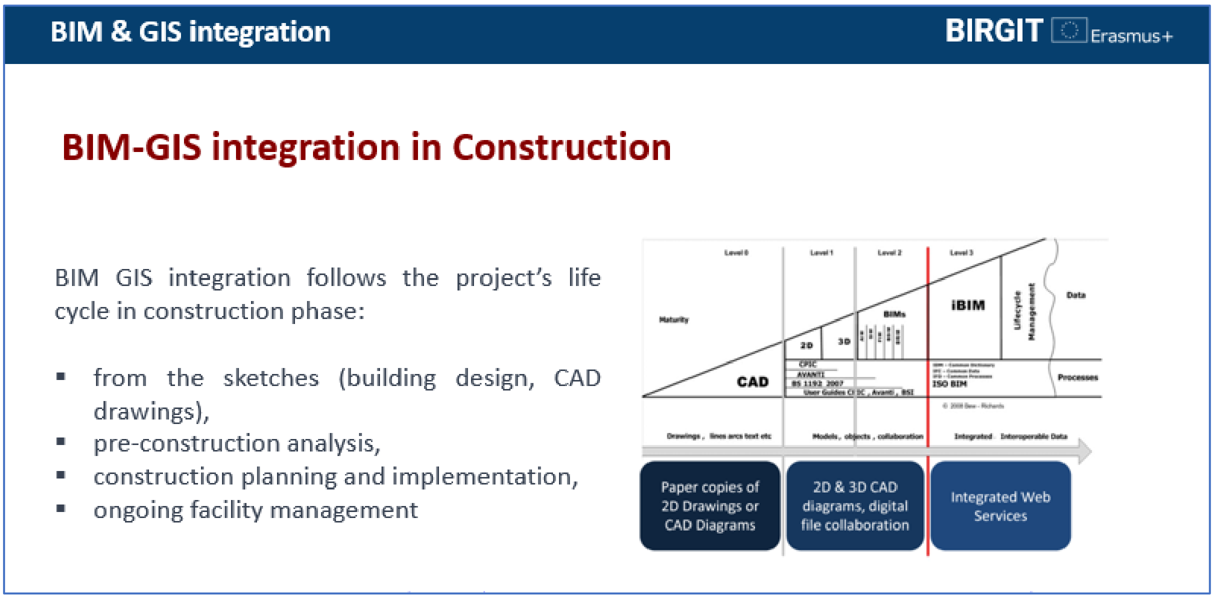
1.2 BIM-GIS in Construction



BIM GIS integration participate in construction phase from the building design, pre-construction analysis, construction planning and implementation, ongoing facility management progressing both with levels of maturity in BIM, as seen in Figure 6:

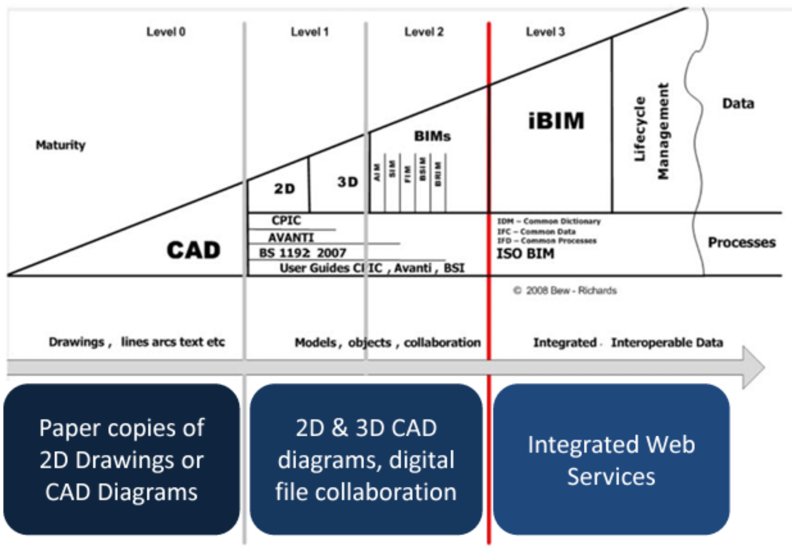


Figure 3 Level of maturity of BIM presented in (URL 6)

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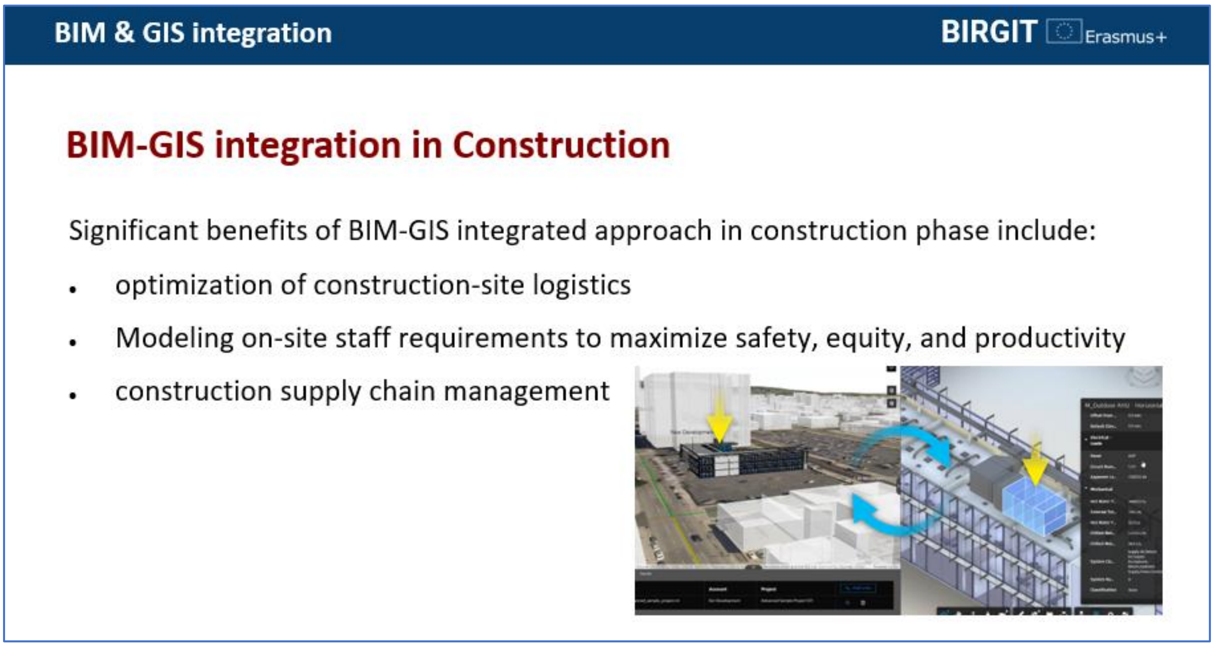

Also in the construction phase, a range of applications benefit from an integration. In construction-site logistics, for example, the locations of cranes and storage areas can be planned regarding the surroundings. The planning and scheduling of (heavy) transports can also be performed using geospatial data from semantic 3D city and landscape models. It is also possible to track and observe the environmental regulations during the construction phase by using the integrated BIM-GIS model. Seen in (Schaller et al. (2017)) the integration of BIM with GIS proves crucial in ensuring regulatory compliance and optimizing the construction process. The construction sequence plan derived from BIM can be effectively juxtaposed with regulations (example: governing the removal of woody plants to adhere to species protection guidelines).

Significant benefits of BIM-GIS integrated approach in construction phase include:

- optimization of construction-site logistics
- Modeling on-site staff requirements to maximize safety, equity, and productivity
- construction supply chain management

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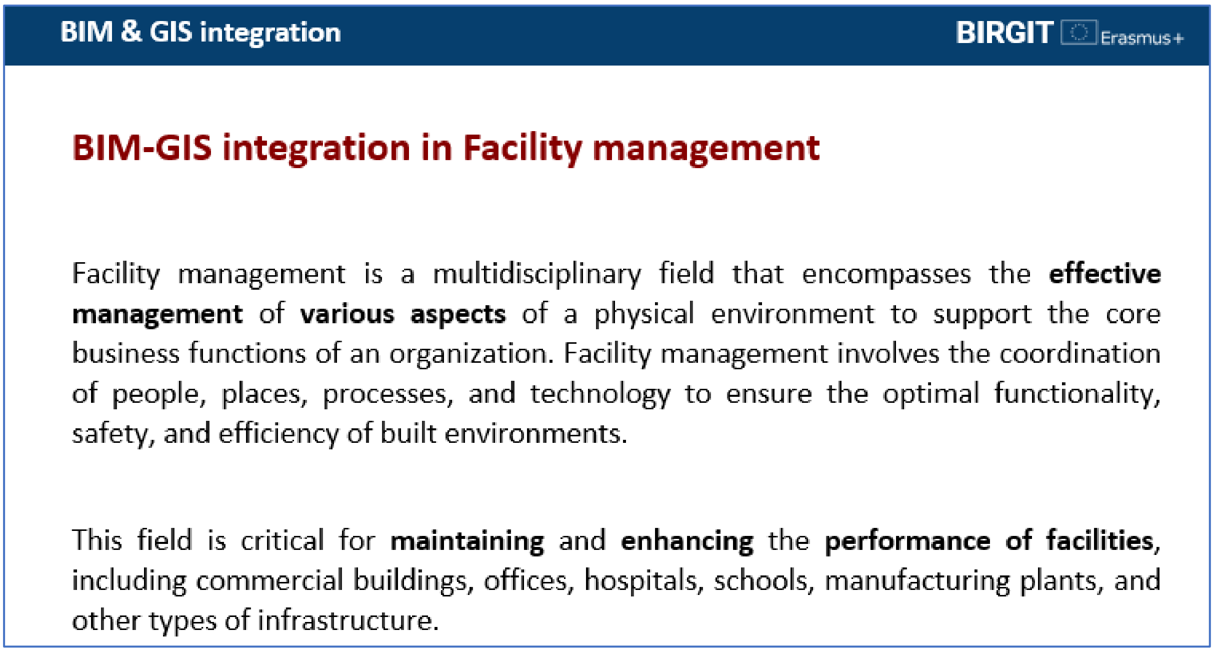
1.3 BIM-GIS in Facility Management



Facility management is a multidisciplinary field that encompasses the effective management of various aspects of a physical environment to support the core business functions of the building or organization. Facility management involves the coordination of people, places, processes, and technology to ensure the optimal functionality, safety, and efficiency of built environments. This field is critical for maintaining and enhancing the performance of facilities, including commercial buildings, offices, hospitals, schools, manufacturing plants, and other types of buildings or infrastructure.

The largest part of a building's lifetime cost goes to operation and maintenance. For those who have responsibility for facility management, it is therefore crucial to ensure that management takes place as optimally and cost-effectively as possible. The availability of comprehensible data and information is crucial to succeed in this.

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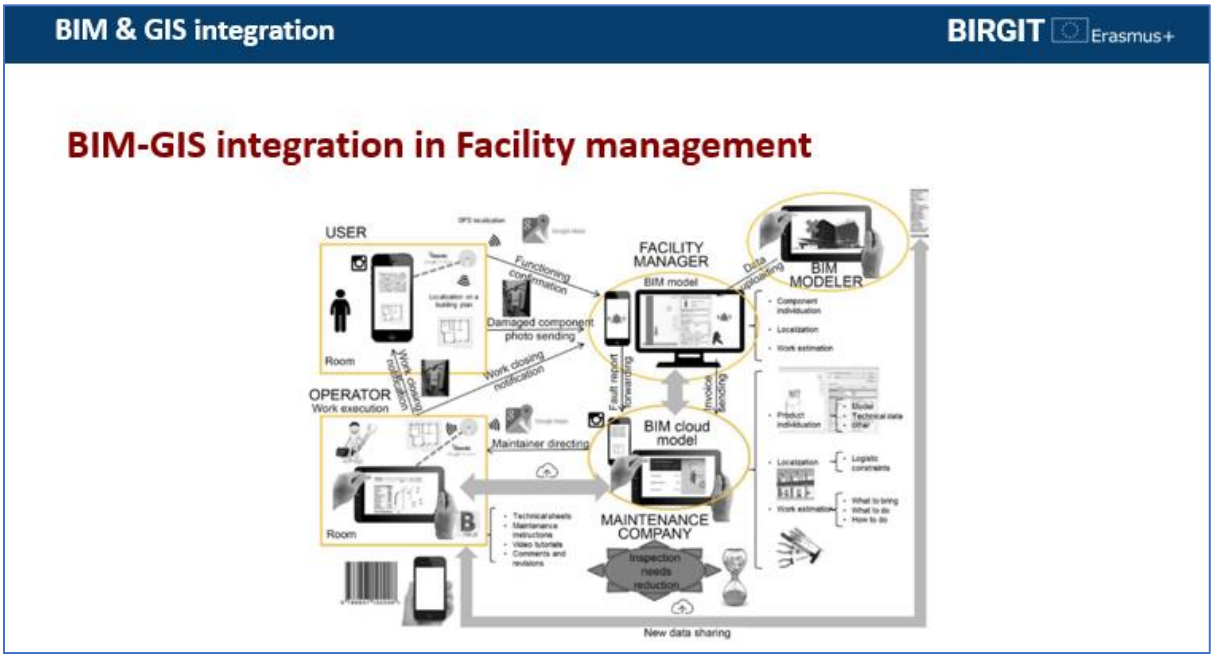

It is said that in every bigger structure, after a few years of operation, 10% of the area is usually under reconstruction. Hospitals might change the function of some rooms, shopping malls might change some of the rooms to another tenant, and roads might need partial recarpeting. The cost of annual operations is usually predicted as a percent of the total cost of the construction of the structure. Depending on the type of structure, it might range between 1% in the case of flats, 2-3% for motorways, and up to 6% for hospitals (URL 8). Civil and building structures are designed for 50-100 years of use, with every 10-15 years' operating costs peak, which is due to inevitable renovations or remodeling of part of the structure. As it can be easily calculated, the design and construction phase cover less than half of the total costs incurred during the structure lifecycle. It stands contrary to a popular belief that operating costs run at 80% of the total cost of a construction project. This applies only to technically complicated structures in which multiple systems must be always operational and efficient, e.g. hospitals, and laboratories.

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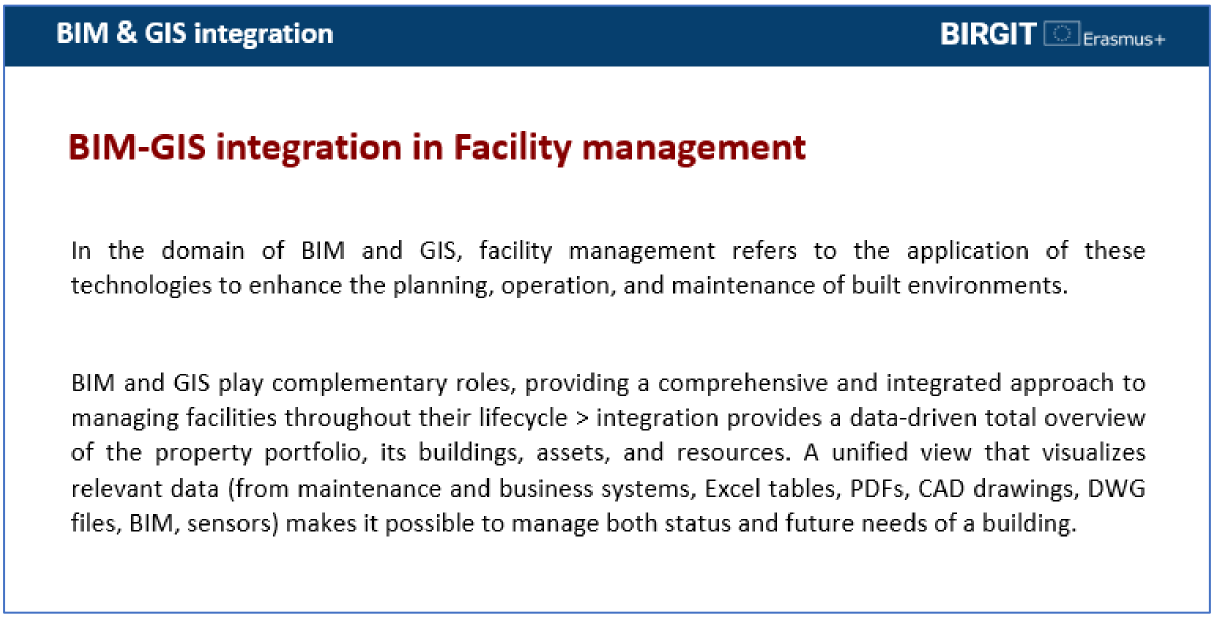

In the domain of BIM and GIS, facility management refers to the application of these technologies to enhance the planning, operation, and maintenance of built environments. BIM and GIS play complementary roles, providing a comprehensive and integrated approach to managing facilities throughout their lifecycle. The aim of BIM GIS integration in facility management is to have an interface that provides a data-driven total overview of the property portfolio, its buildings, assets, and resources. A unified view that visualizes relevant data (from maintenance and business systems, Excel tables, PDFs, CAD drawings, DWG files, BIM, sensors) makes it possible to manage both status and future needs of a building.

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BIM & GIS integration — BIRGIT Erasmus+

GIS strength in Facility management

- GIS adds a spatial dimension to facility management by incorporating geographic data. It includes information about the facility's location, topography, climate, and surrounding infrastructure.
- GIS enables the mapping and analysis of spatial data related to facilities. This can include mapping utility networks, assessing environmental impact, and understanding the broader context of the facility in its geographic surroundings. And to see trends, for example in the form of recurring error reports in a certain location
- GIS is used to overlay facility information with zoning regulations, environmental constraints, and other geospatial data to ensure compliance with local regulations.
- GIS aids in emergency planning and response by visualizing evacuation routes, assessing the impact of natural disasters, and facilitating quick decision-making during crises.

Within the BIM-GIS integration in Facility management, GIS contributes to data-driven operational and decision support for facility management, which provides advantages such as quickly and efficiently:

- GIS adds a spatial dimension to facility management by incorporating geographic data including information about the facility's location, topography, climate, and surrounding infrastructure
- GIS enables the mapping and analysis of spatial data related to facilities through the mapping utility networks, assessing environmental impact, and understanding the broader context of the facility in its geographic surroundings, and to notice trends (for example in the form of recurring error reports in a certain location)
- GIS is used to overlay facility information with zoning regulations, environmental constraints, and other geospatial data to ensure compliance with local regulations
- GIS aids in emergency planning and response by visualizing evacuation routes, assessing the impact of natural disasters, and facilitating quick decision-making during crises

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Within the utility and infrastructure management GIS is commonly used for managing utilities, infrastructure assets, and public facilities. After construction, BIM data can be used to create digital twins of buildings and infrastructure. By integrating GIS with BIM, organizations can maintain an accurate digital representation of both underground and aboveground infrastructure. these digital twins provide facility managers with real-time data on asset performance, maintenance schedules, and energy consumption. This supports more efficient facility management within the maintenance, repair, and asset management throughout the asset's lifecycle.

BIM on the other hand enhance the facility management in its advantages as follows:

- BIM is initially employed during the design and construction phases to create a detailed digital representation of the facility. This digital model includes information about the building's geometry, materials, components, and systems.
- BIM facilitates the integration of diverse data sources related to building components, equipment, and systems (maintenance schedules, specifications, and performance details)
- BIM provides a visual representation of the facility, enabling facility managers to navigate through the virtual model and understand the spatial relationships among different elements
- BIM captures lifecycle information, allowing facility managers to access historical data, track changes, and make informed decisions about maintenance and upgrades

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For those who are interested in more on BIM GIS integration in Facility management:

The integration of BIM and GIS in facility management ensures comprehensive data management by combining geometric and spatial information. This approach provides a holistic view of the facility, enhancing decision-making processes. BIM-GIS integration fosters collaboration among stakeholders by providing a common platform for sharing information which enhances communication and coordination among architects, engineers, facility managers, and other involved parties. Also, the combined use of BIM and GIS streamlines facility operations by integrating data on building components, spatial relationships, and external factors. This synergy results in more efficient maintenance, optimized space utilization, and improved overall facility performance.

Facility management within the domains of BIM and GIS involves leveraging these technologies to optimize the planning, operation, and maintenance of facilities. The integration of BIM and GIS offers a powerful toolset for facility managers, allowing them to make data-driven decisions, enhance spatial understanding, and ensure the longevity and sustainability of built environments.

Facility management, emergency management, and seamless indoor-outdoor transitions are examples for applications requiring the integration of BIM and semantic 3D city models from the maintenance phase of a building. Hijazi et al. (2011) show, for example, how indoor and outdoor utility networks can jointly be analyzed for building maintenance purposes.

The challenge in BIM GIS integration in facility management is to keep enough information for a strong overview for a decision making in management and maintenance of a building and leave out the information that are just storage consuming. Having in mind that balance, it is necessary to have in mind (URL 8) :

1) the challenge of setting up a systemic, efficient and consistent handover of information, that would be relevant and usable in all stages, i.e. there are different needs in e.g. construction phase than for maintenance

2) the longevity or lifespan of a built asset, which can run into 100+ years. Data may still may become redundant and unreadable due to data storage format and software version changes. The use of internationally defined data models and processes to manage the information generated by a project are addressing this challenge.

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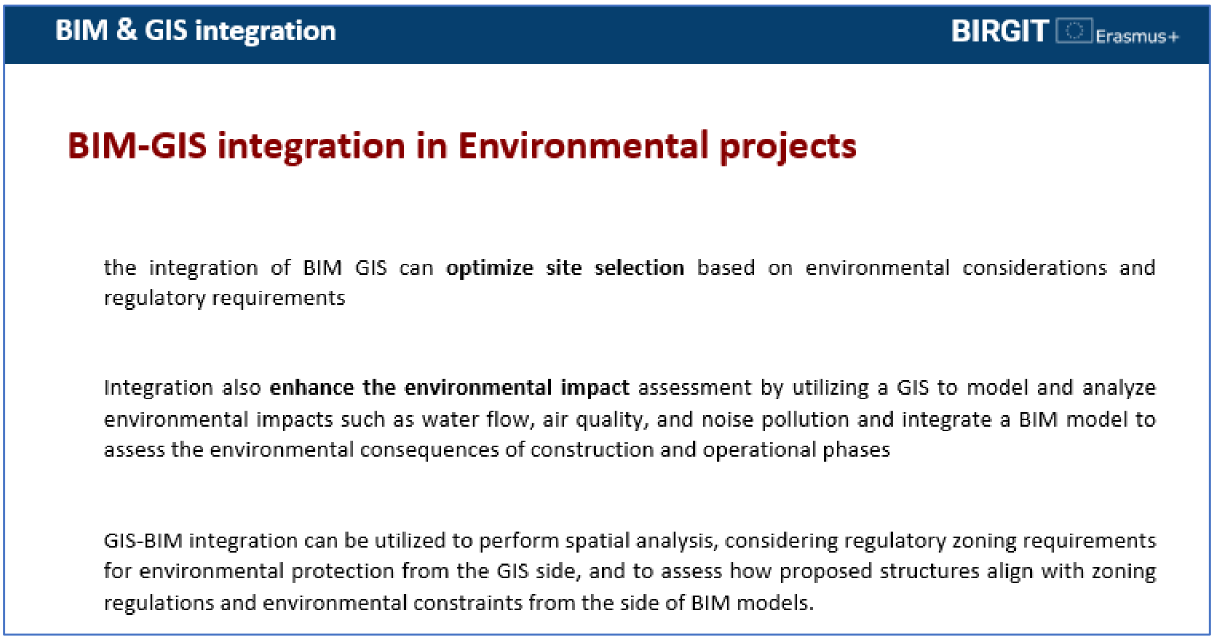
1.4 BIM-GIS in Environmental projects



Environmental projects are initiatives designed to address issues related to the natural world and promote sustainability. They often involve activities such as conserving ecosystems, reducing pollution, promoting renewable energy, managing waste, and encouraging sustainable land use practices. These projects aim to protect the environment, preserve biodiversity, and mitigate the impact of human activities on the planet.

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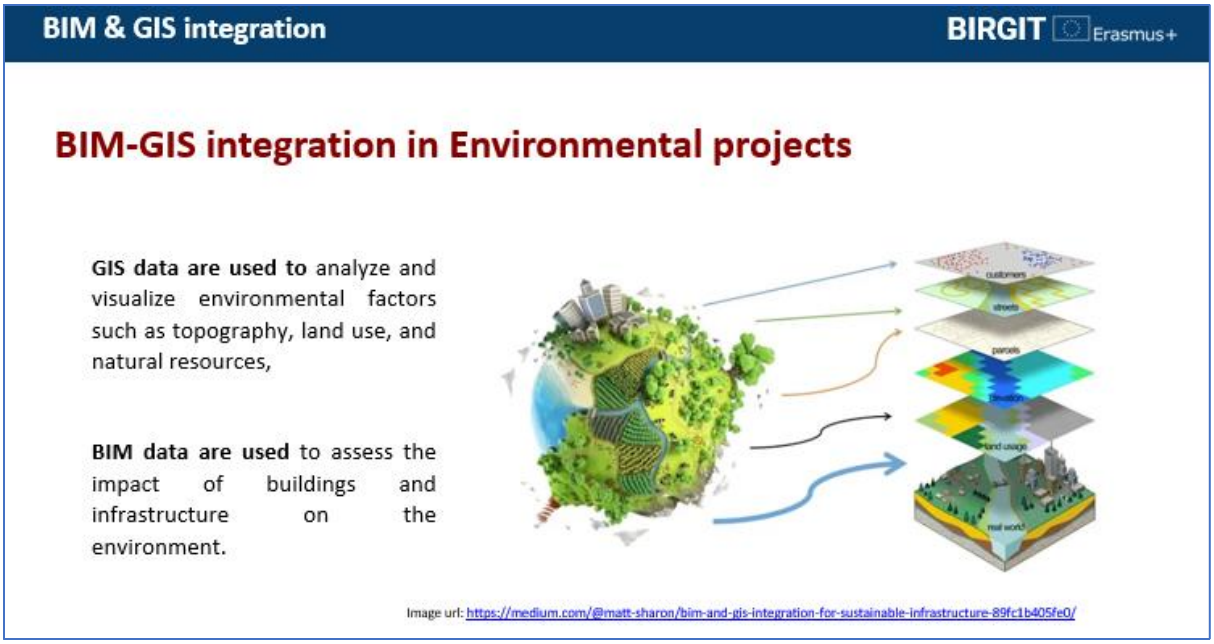

The most significant advantages of a BIM GIS integration in environmental projects lies in site selection and planning where GIS data can be used to analyze and visualize environmental factors such as topography, land use, and natural resources, and BIM models to assess the impact of buildings and infrastructure on the environment. Therefore, the BIM-GIS integration can optimize site selection based on environmental considerations and regulatory requirements. Integration can also enhance the environmental impact assessment by utilizing a GIS to model and analyze environmental impacts such as water flow, air quality, and noise pollution and integrate a BIM model to assess the environmental consequences of construction and operational phases.

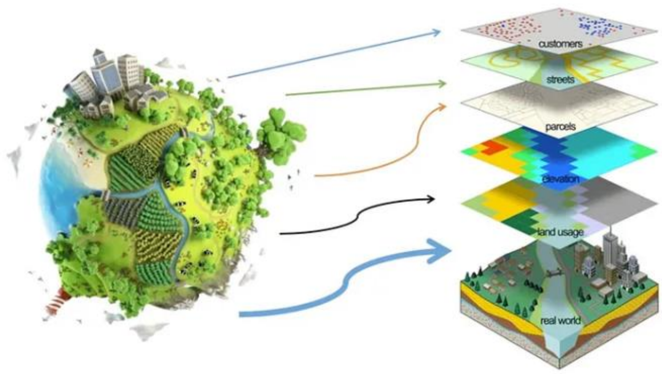

Figure 4 BIM-GIS integration in environment projects(URL 9)

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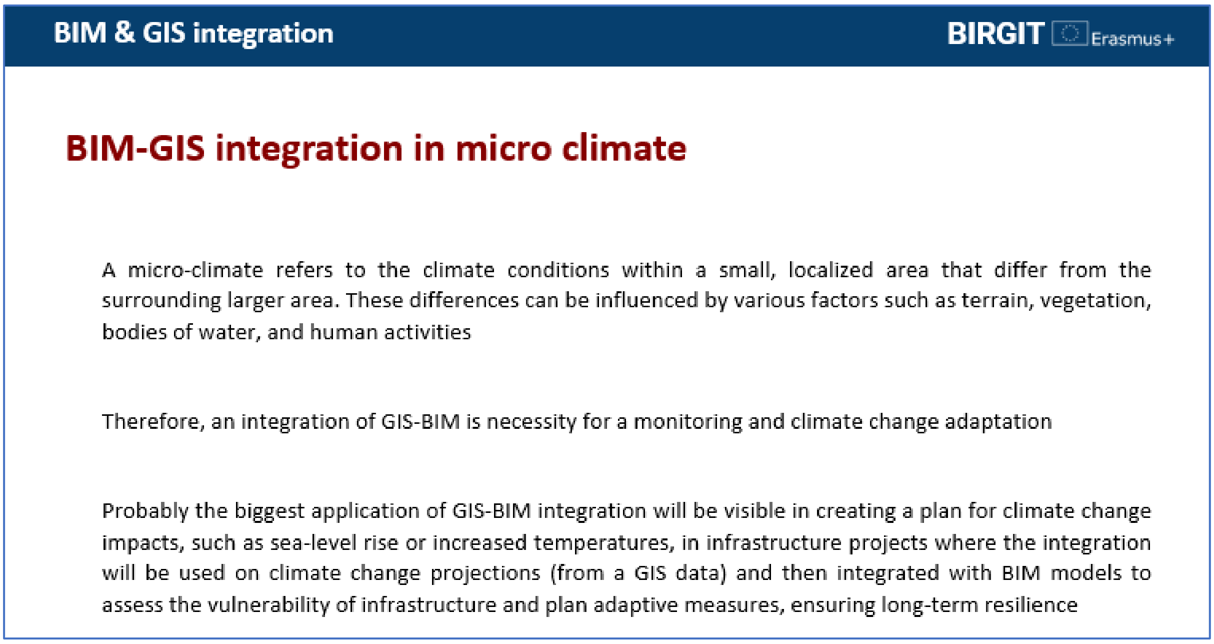
Application of BIM-GIS integration in regulatory compliance assessment is increasing application of this integration. In the context of GIS-BIM integration for environmental projects, regulatory compliance refers to the adherence to established laws, regulations, and standards governing environmental impact assessment, construction, and ongoing operation. In that sense, integration of GIS-BIM can be utilized to perform spatial analysis, considering regulatory zoning requirements for environmental protection from the GIS side, and to assess how proposed structures align with zoning regulations and environmental constraints from the side of BIM models.

Today's environmental projects are well regulated by a national or global institutions which require regular reporting on environmental projects, their life cycle and its usage. At that point an integration of GIS-BIM enabled a seamless data exchange between GIS and BIM and the generation of reports required by regulatory agencies. The agencies are strict to change requests in a environmental projects and they have to be very well explained. BIM-GIS integration enables updating a GIS and BIM models accordingly to monitoring changes in environmental regulations and to implement a change management process to assess the impact of regulatory updates on ongoing or planned projects and make necessary adjustments.

1.4.1 BIM-GIS in micro climate



A micro-climate refers to the climate conditions within a small, localized area that differ from the surrounding larger area. These differences can be influenced by various factors such as terrain, vegetation, bodies of water, and human activities and furthermore, microclimates can result in variations in temperature, humidity, wind patterns, and precipitation within a relatively small area, often leading to unique environmental conditions compared to the broader surrounding region.

An integration of GIS-BIM is necessity for a monitoring and climate change adaptation. Probably the biggest application of GIS-BIM integration will be visible in creating a plan for climate change impacts, such as sea-level rise or increased temperatures, in infrastructure projects where the integration will be used on climate change projections (from a GIS data) and then integrated with BIM models to assess the vulnerability of infrastructure and plan adaptive measures, ensuring long-term resilience.

One prominent use case involves optimizing building design for energy efficiency and thermal comfort. By coupling GIS data, which provides detailed spatial information on local climate conditions, with BIM models that encompass the geometrical and thermal properties of buildings, planners can conduct comprehensive microclimate analyses. This integration enables the simulation of various design scenarios, evaluating the impact of building configurations, materials, and orientations on local microclimates. For instance, it allows for the assessment of shading effects on neighboring structures and open spaces, aiding in the development of energy-efficient building layouts that mitigate heat islands and enhance thermal comfort.

One of the examples in a real world is application in a water resource management where the GIS-BIM are being integrated to plan and manage water resources in a watershed to mitigate flooding and preserve ecosystems. In that case, GIS data is used to provide the data on hydrology, land usage, and water flow then integrated with BIM models to simulate the impact of construction projects on water systems and optimize water resource management strategies. Also, the GIS-BIM integration is used and vice-versa, on a sites where the construction near a shallow waters is already been built and where the GIS-BIM integration is used to model and examine how increase of a water level could threaten with flooding the construction or a how much is a construction exposed to a change in water flow around it.

Another use case involves the assessment of urban green spaces and their influence on microclimates. GIS can supply data on land cover, vegetation density, and topography, while BIM models can incorporate detailed information on buildings and other structures. Integrating these datasets enables the analysis of how green spaces contribute to local microclimate regulation, including temperature moderation and the reduction of air pollutants. Planners can use this information to strategically position green infrastructure within urban environments, fostering more sustainable and climate-resilient cityscapes.

Significant exponentially arising potential area where GIS-BIM integration can be applied for microclimate analysis and is already applied, is in the development of smart cities or sustainable urban districts. In that case, city planners use GIS data to analyze existing microclimate conditions such as temperature variations, wind patterns, and solar radiation across an urban area. This GIS data can be integrated with BIM models representing individual buildings to simulate and assess the impact of different building configurations, materials, and orientations on the local microclimate.

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1.4.2 BIM-GIS in green building

Urban green space planning involves the strategic design, development, and management of green areas within urban environments to enhance the quality of life for residents and contribute to the ecological sustainability of cities. Academic literature in urban planning emphasizes the multifaceted benefits of green spaces, including the promotion of physical and mental well-being, biodiversity conservation, and the mitigation of urban heat island effects. Research often explores the optimization of green space layouts, sizes, and distributions to maximize accessibility, recreational opportunities, and environmental functionality.

GIS is frequently employed in these studies to analyze spatial data, assess existing green infrastructure, and model potential interventions, while BIM may be used for detailed 3D visualization and simulation of proposed green space designs, aiding in comprehensive urban planning strategies that prioritize sustainability and community well-being.

Nowadays most used application of GIS-BIM integration in an urban green space planning is visible in applying it to design and plan urban green spaces to enhance biodiversity and provide recreational areas. Integration utilize the advantages of a GIS data on existing green spaces and ecological corridors integrated with BIM models to visualize and optimize the design of parks, gardens, and other green infrastructure elements.

Most notable examples of urban green space planning initiatives that have integrated GIS and BIM principles

Zaryadye Park, Moscow, Russia: Zaryadye Park is an urban park located near the Kremlin in Moscow. The project aimed to transform an underutilized area into a modern and environmentally sustainable public space. GIS was employed to analyze the existing urban conditions, including topography and land use, while BIM was used for detailed design and visualization. The integration of GIS and BIM allowed the planners to assess the ecological impact, optimize the layout, and simulate various design scenarios. The park features different zones representing various Russian landscapes and ecosystems, showcasing the integration of environmental considerations with urban design.

Millennium Park, Chicago, USA: Millennium Park in Chicago is a renowned urban park that underwent significant redevelopment. GIS was utilized to analyze the existing cityscape, and BIM was employed for precise modeling of structures and landscape elements. The integration of these technologies facilitated the planning and design of the park, optimizing the use of space for both aesthetic and functional purposes.

Singapore Green Plan 2012: Singapore's Green Plan 2012 involved comprehensive urban planning to enhance the city-state's green spaces. GIS was instrumental in analyzing land use patterns, identifying suitable areas for green development, and assessing environmental factors. BIM technology was integrated for the detailed modeling of structures within these green spaces, ensuring effective and sustainable urban design.

London Olympic Park, UK: The redevelopment of the Olympic Park in London for the 2012 Summer Olympics incorporated GIS for site analysis, assessing factors like land use and transportation. BIM was employed to design and visualize the park's structures, ensuring that green spaces were seamlessly integrated. This approach allowed for efficient planning and sustainable development of the park.

West Kowloon Cultural District, Hong Kong: The West Kowloon Cultural District in Hong Kong utilized GIS to analyze the urban context, considering factors such as population density and accessibility. BIM was then applied for the detailed planning and design of the cultural facilities and green spaces. This integrated approach helped in optimizing the use of available space for cultural and recreational purposes.

The integration of GIS and BIM in green urban planning, while offering substantial benefits, presents noteworthy challenges. The substantial initial costs associated with acquiring, implementing, and maintaining these integrated systems, coupled with resource constraints, pose financial challenges for smaller municipalities or organizations. Additionally, concerns related to data privacy and security, the absence of standardized protocols for GIS-BIM integration, resistance to change, and the scale and complexity of urban planning projects further underscore the complexities associated with the utilization of GIS-BIM integration in green urban planning. Addressing these challenges necessitates ongoing technological advancements, standardization efforts, and a concerted effort to cultivate a culture of collaboration and innovation within organizations.

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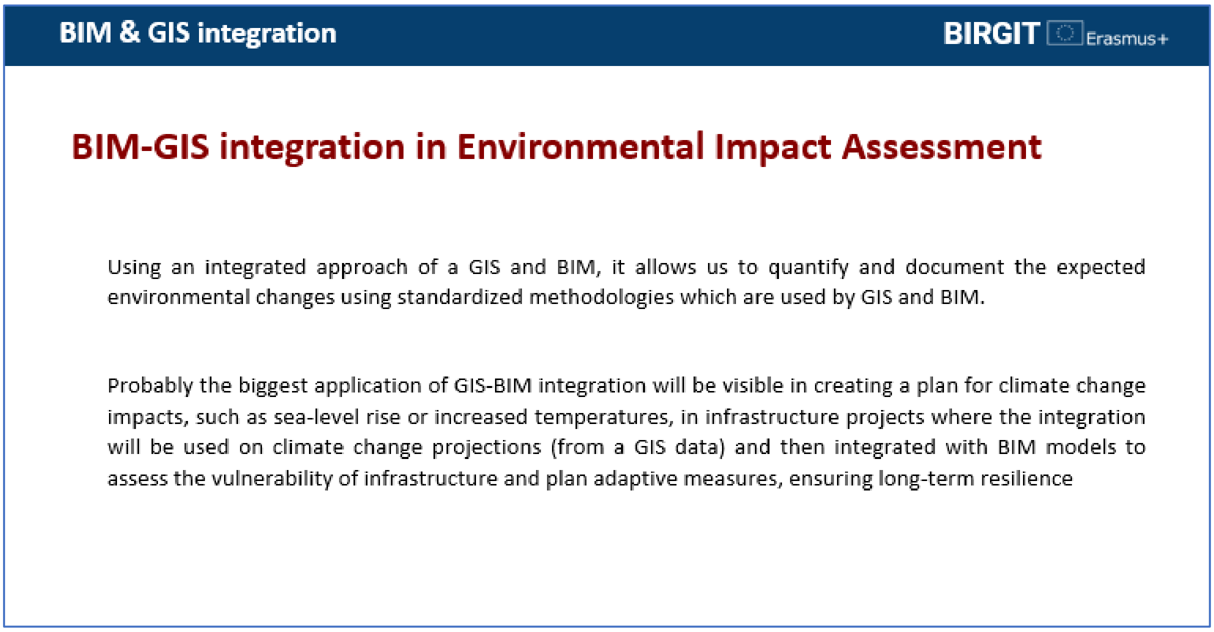
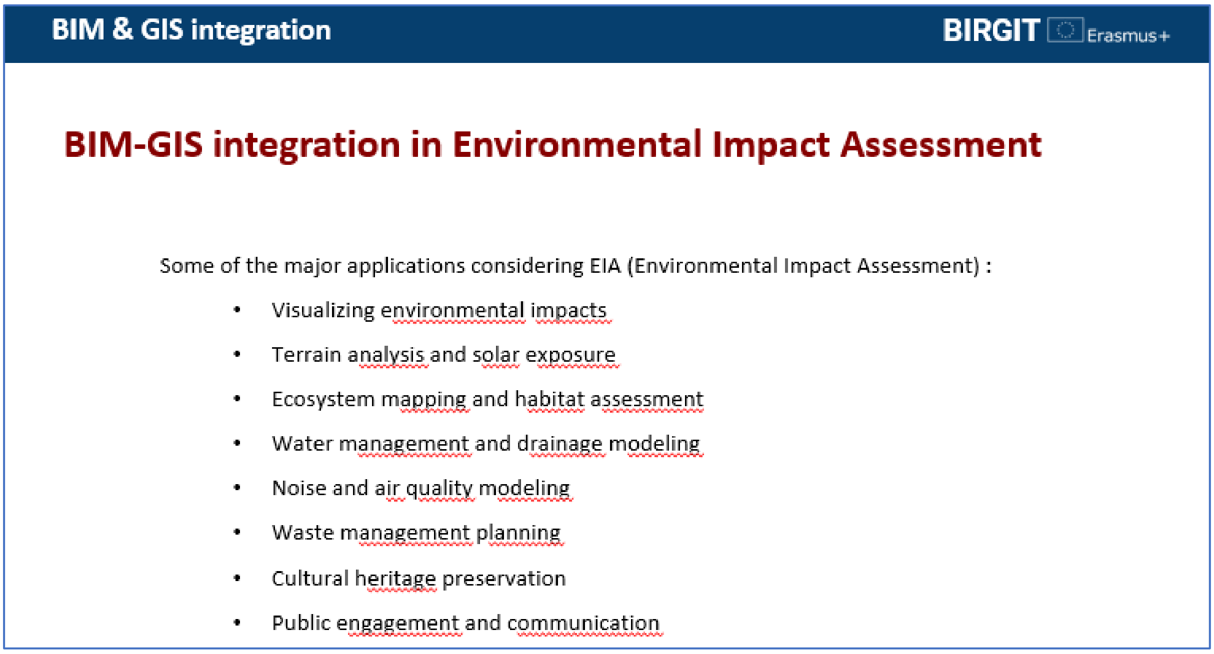
1.5 BIM-GIS in Environmental Impact Assessment and Life Cycle Assessment



As mentioned in earlier chapters, and also applicable to the Environmental Impact Assessment (EIA), the integration of GIS and BIM is mostly used to model and analyze environmental parameters such as air quality, water flow, and soil composition using a GIS parameters, and to simulate and evaluate the potential impact of construction and infrastructure projects on the environment using a BIM model parameters. Using an integrated approach of a GIS and BIM, it allows us to quantify and document the expected environmental changes using standardized methodologies which are used by GIS and BIM.

Possible use case could be assessing the impact of a new infrastructure development on local ecosystems and habitats where integration could contribute with GIS data to provide baseline environmental information, and BIM models which could simulate construction scenarios, allowing for a comprehensive EIA by analyzing potential changes in the environment.



There are a lot of application of BIM GIS integration in EIA nowadays. The integration can be used in visualizing environmental impacts where BIM is used to model the design of a proposed infrastructure project and integrated with GIS to visualize and analyze the potential environmental impact assessing the proximity to sensitive ecosystems, water bodies, or protected areas. The integration can also be applied in terrain analysis and solar exposure by combining GIS terrain data with BIM models which enables analyzes of the project's impact on natural landscapes, drainage patterns, and solar exposure and can discover potential alterations to the terrain and shadows cast by new structures. Ecosystem mapping can be enhanced by BIM GIS integration in a manner where utilizing GIS to map existing ecosystems and integrating it with BIM to assess how the proposed project might impact habitats includes evaluating changes in vegetation cover, wildlife corridors, and biodiversity. And also, in water management and drainage modeling, BIM GIS integration has an important role where by integrating BIM data on building structures with GIS data on topography to model and analyze water runoff and drainage patterns which can help predicting and mitigating potential issues related to flooding or changes in water flow. In noise and air quality modeling using BIM to model proposed structures and GIS to analyze existing environmental conditions, such as population density and transportation networks which allows for simulations of potential noise and air quality impacts on the surrounding environment.

The integration has significant role in waste management planning where incorporating BIM information on material usage and construction processes with GIS data on waste disposal facilities and regulations assists in planning for proper waste management and minimizing the environmental impact of construction activities.

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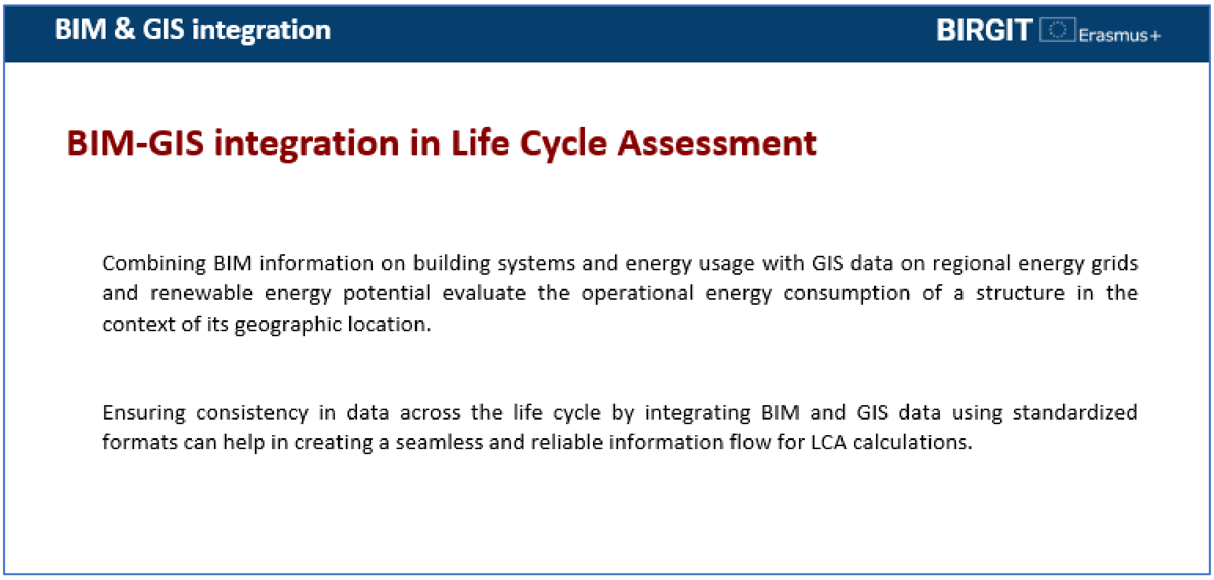
Integrating BIM models with GIS data containing information about cultural heritage sites, historical landmarks, or archaeological areas can aid in assessing potential impacts on cultural heritage and implementing measures for preservation. Also, combining BIM visualizations with GIS mapping for effective communication with stakeholders can facilitate public engagement by providing easily understandable representations of the proposed project and its environmental implications.



The integration of BIM and GIS in Life Cycle Assessment (LCA) can assess the environmental impacts of construction projects and built environments throughout their entire life cycle. BIM contributes detailed information about the physical attributes and material composition of structures, while GIS provides spatial context and environmental data.

Integrating GIS data on regional ecosystems, biodiversity, and environmental sensitivity with BIM models helps understanding the broader environmental context and potential impacts on local ecosystems during the construction and operation phases. Ensuring consistency in data across the life cycle by integrating BIM and GIS data using standardized formats can help in creating a seamless and reliable information flow for LCA calculations.

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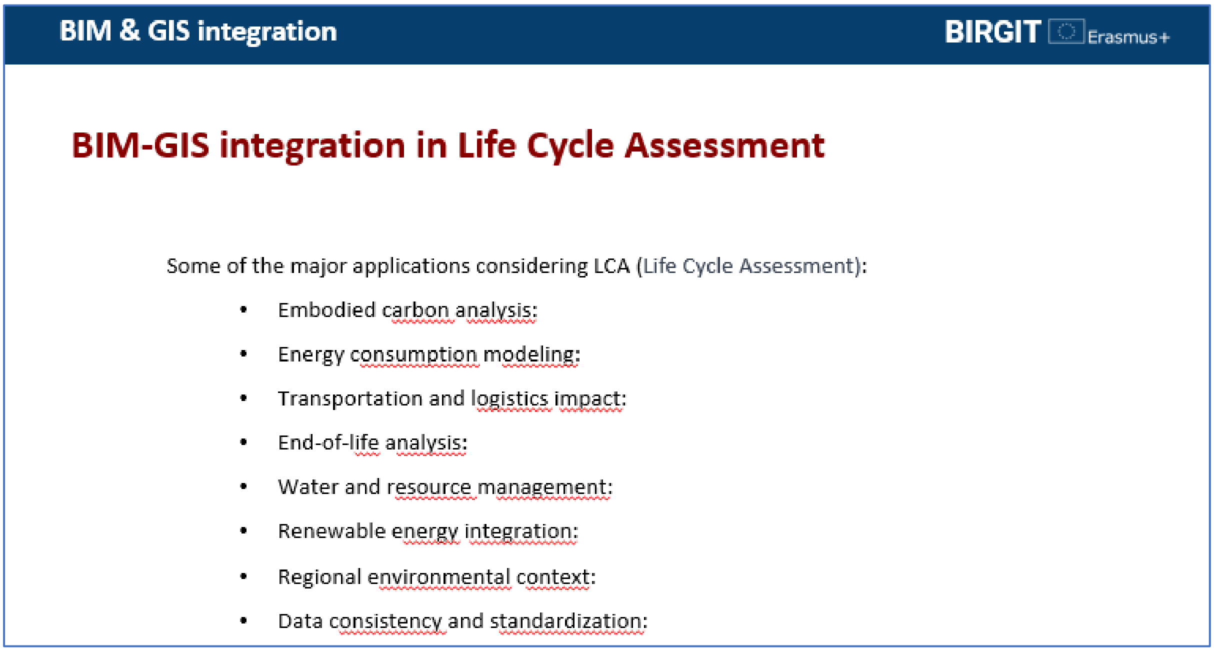

There are a lot of examples of how BIM-GIS integration is applied in Life Cycle Assessment nowadays, and some are mentioned here in text. Using BIM data to model the construction materials and components of a building and integrating it with GIS data on the environmental impact of material extraction, manufacturing, and transportation allows for a more accurate assessment of the embodied carbon in construction. Combining BIM information on building systems and energy usage with GIS data on regional energy grids and renewable energy potential evaluate the operational energy consumption of a structure in the context of its geographic location. Utilizing GIS to analyze transportation routes and logistics networks and integrating this information with BIM data on construction materials and supply chains assess the environmental impact of transportation activities throughout the life cycle. Integrating BIM models with GIS data to assess the environmental impact of demolition, disposal, or recycling processes includes evaluating the transportation of waste materials to recycling facilities or landfills and considering the geographic implications of disposal methods. Using BIM to model water-efficient systems within a building and integrating it with GIS data on local water resources and consumption patterns can assess the environmental impact of water usage and contributes to sustainable water management practices. Combining BIM data on building orientation and design with GIS information on solar potential and wind patterns facilitates the assessment of renewable energy generation potential and the environmental benefits associated with on-site renewable energy sources.