



*Course: BIM introduction. Block 1: BIM definition. Lecture 1.2*

# Benefits and challenges using BIM

## Lecture Notes

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### **License**



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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 differences between CAD and BIM
- Understand role of BIM in diverse phases of building life-cycle
- Name benefits of challenges of BIM use
- Discuss factors slowing down BIM implementation



### **Summary**

This lecture explains the differences between CAD and properly performed BIM, with focus on BIM as a process, not only 3D models of assets. Further, the lecture provides introduction into life-cycle of an asset, from the early idea and design through construction to operation, and the role of BIM in these steps. The focus lies on benefits of BIM usages, but also names challenges of BIM implementation and possibility how to deal with these issues.

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

No specific pre-requisites required.

### **Expected Workload**

10 slides with course learning content, 2 hours

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## Revision History:

Revision	Date	Author(s)	Status	Description
0.1	2024-01-04	A. Kubart	Draft	First Draft
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1.0	2024-03-11	A. Kubart	Published	Edited by M. Morbidini
1.1	2024-11-18	A. Kubart	Published	Edited by T. Näslund
2.0	2025-04-29	A. Kubart	Published	Updated EU logo and disclaimer. Edited by T. Näslund

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## CAD versus BIM I

**Benefits and Challenges using BIM**


**CAD versus BIM I**

**CAD – Computer Aided Design**

- focus lies on geometry, defined in points, curves, surfaces and solid volumes

**BIM – Building Information Modelling**

- virtual model with much additional information
- system for cooperation and data-sharing



Source: <https://www.cadtobim.com/what-is-bim.html>

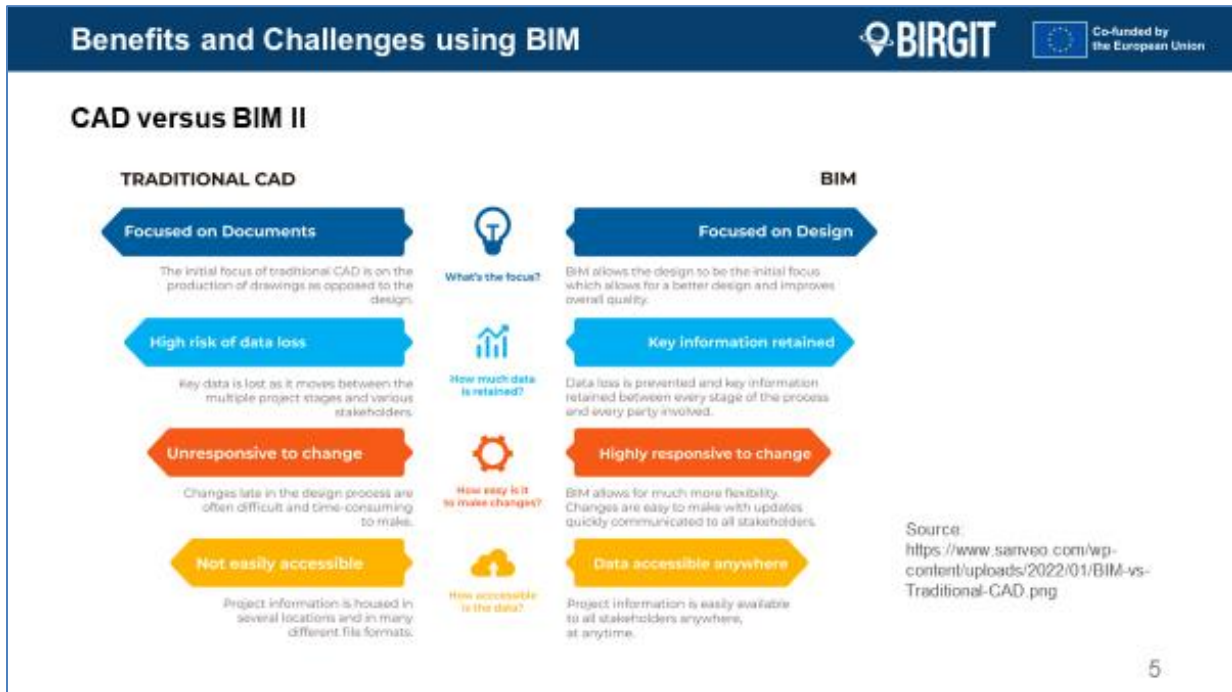
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CAD, or Computer-Aided Design, has traditionally been used in the construction industry for the creation of 2D and 3D drawings. It basically replaced the traditional hand drafting processes with an automated one.

In a CAD environment, the focus lies on geometry and its definition in points, curves, surfaces and solid volumes. For example, if you select a wall, it is represented by two parallel lines and the only available parameter is Line Style. If a change is needed, it has to be done in all relevant separated drawings. Quality checks and coordination of changes are done manually, and information is exchanged as static documents (e.g. pdf files). The data cannot be extracted, queried or edited from these exchange documents.

In BIM, which is object-oriented modelling, this is flipped upside down. The team creates a virtual building model where objects are associated with lot of information that describes them, e.g. function, material, position, cost, relation to other objects and so on. The geometry is just another property that describes these objects.

## CAD versus BIM II



If one changes one BIM drawing, changes will automatically appear in all other documents. The CAD-looking drawings can be generated from the BIM model automatically in real-time. Further, the BIM cloud can provide model access to entire teams, who can analyse, extract, update or modify the information. As such, BIM is a collaborative design environment.

It is important to understand that CAD and BIM are two different approaches. In an ideal world, they should be completely separated from each other. However, it is still common to use CAD first and try to add BIM on top of that, i.e. generate BIM model from the drawings, as BIM is usually the client's requirement. It is of course beneficial to use BIM from the beginning, but it is possible only if everyone on the project works in this way.

## Building and Facility Life Cycle

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**Building / Facility Life Cycle**

- several distinct phases, new buildings planned for 100 years
- each phase involves different activities and stakeholders
- ensuring that the building is safe, functional, and sustainable



PlanDesignBuildOperate

Source: <https://www.autodesk.com/solutions/aec/bim/benefits-of-bim>

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The building or facility life cycle typically consists of several distinct phases, each of which involves different activities and stakeholders. New buildings are planned that should be in use for at least 100 years.

Here's a brief overview of each phase:

**Planning:** In this phase, the project team defines the purpose, goals, and requirements for the building project. This may involve conducting feasibility studies, analysing site conditions, and developing a project budget and schedule.

**Design:** Then, detailed plans and specifications are developed for the building. The design needs to meet the project requirements and comply with building codes and regulations.

**Construction:** The construction phase involves actually building the structure. This includes site preparation, foundation work, framing, electrical and plumbing installation, and finishing work such as painting and flooring.



**Operations and maintenance:** Once the building is complete, it must be operated and maintained to ensure its longevity and functionality. This involves activities such as cleaning or HVAC maintenance, and routine repairs.

**Renovation and demolition:** Over time, the building may need to be renovated or upgraded to meet changing needs or standards. This can involve anything from minor updates to major structural changes. Eventually, the building may reach the end of its useful life and need to be demolished. This may be due to structural deterioration, changing land use needs, or other factors.




## BIM benefits during design and construction I

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### BIM Benefits in Design and Construction I

- Many experts participating on any project
- Cooperation
- Data sharing
- Model checks
- Solving problems that would otherwise appear first on the construction site





Source - <https://bimcorner.com/benefits-of-using-bim-technology/>

Many experts participate on the design of any building. They create several discipline-specific models, e.g. for architectural design or piping. These models are then merged together to an integrated (merged) model. (We will speak closer about it in following lectures). When merging the specific models together, inaccuracies or errors can appear. Luckily, the merged digital model can be analysed in detail already during the planning and design phase, before the physical construction of the building. In that way, one can solve the possible problems, which otherwise would arise first on the construction site.

The BIM model will never be 100% true to reality. Though, it still helps to avoid many mistakes and therefore it pays off. We should point out that the greater the project, the more and bigger mistakes happen and with BIM, they can be detected and targeted. Importance of effective communication and coordination also increases with the project scope.

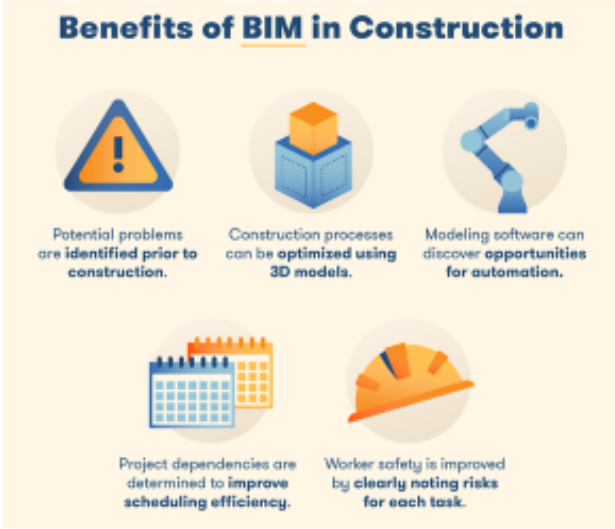
## BIM benefits during design and construction II

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### BIM Benefits in Design and Construction II

#### Benefits of BIM in Construction



Potential problems are identified prior to construction.

Construction processes can be optimized using 3D models.

Modeling software can discover opportunities for automation.

Project dependencies are determined to improve scheduling efficiency.

Worker safety is improved by clearly noting risks for each task.

BIM speeds up project times about 20-50%, compared to traditional CAD approach

Estimation of cost and impacts of different design choices

Several teams can work on the same model, immediate changes

Source: <https://acropolis-wp-content-uploads.s3.us-west-1.amazonaws.com/what-is-bim-2.png>

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BIM use results in faster design and construction; it is estimated that BIM speeds up project processing times about 20-50%, compared to traditional CAD approach.

That is possible because of:


- The precise design with reduced errors. The single merged 3D model allows verifying interferences between the discipline-specific models. Eventual collisions are detected in the early stages of the project.
- Increased efficiency as the specific models can be updated almost immediately and the changes will appear in all connected documents.
- Estimation of impacts of different design choices and scenario testing. BIM models make it possible to accurately and automatically analyse costs, timescales and environmental footprints. As such, the project team can highlight the best variant. As for the result, the final design will be in line with the budget and requirements.
- BIM models are shared among teams, meaning that several people can work on the same model at the same time and the changes to the model will be shared in real-time. The work is also optimized by this way, avoiding repetitions.

It is possible to prefabricate selected components which speed up the construction later on.

## BIM benefits for Facility Management I

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**BIM benefits for Facility Management (FM) I**



- Operation can take up to a hundred years
- Updates, renovation and repairs are necessary
- Older buildings – documentation as drawings and/or .pdf files
- New buildings – optimally have "as-built" BIM model with info optimized for FM

<https://www.advenser.com/wp-content/uploads/2022/10/bim-for-fm.jpg>

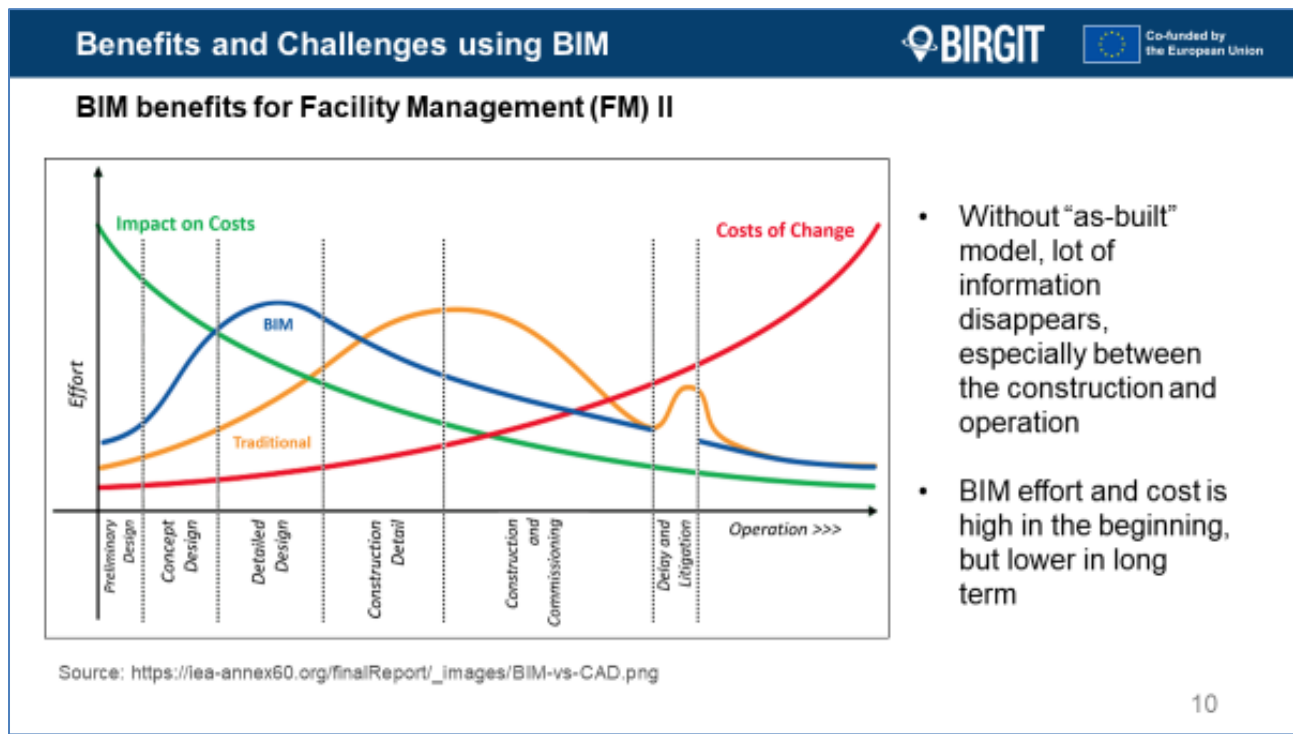
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BIM helps to optimize resources even in later stages of the building LC. While building design and construction take just several years, the operation can take up to a hundred years.

Updates, renovation and repairs are necessary during the operation. For older buildings, the utility/FM information is either unavailable or is available in (usually 2D CAD) drawings. It is very difficult to find and extract such information from the drawings.

Newer, BIM modelled buildings, should have their Digital Twin with information needed for the FM, such as planned renovation, supplier, materials etc. Altogether, this is called "as-built" documentation, and it can be exported from the merged BIM model as FM model (*more later in the course*). Providing the FM model with correct updated data is an important part of building hand-over.

## BIM benefits for Facility Management II



Without the FM model, lot of information disappears, especially between the construction and operation phases. That is because any professional team usually does its job and jumps into the next project, no longer interested in the old one. Later re-developing of the lost data of course increases maintenance costs. During the long term of the operation, these costs would be higher than to optimize design and hand-over with BIM.

In other words, BIM effort and cost is high in the beginning, but lower in long term. The savings made with the correct hand-over are often underestimated. The figure illustrates the differences in effort, impact and cost of changes with and without proper BIM.

## Reducing environmental impacts with BIM

Benefits and Challenges using BIM
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### Reducing environmental impact with BIM

Both energy and material savings

- Alternative material
- On-site logistics
- Exact need of materials
- Re-use of materials after renovation /demolition

[https://www.elogictech.com/uploads/uploaded\\_image/s/1556103413\\_green-building-01.jpg](https://www.elogictech.com/uploads/uploaded_image/s/1556103413_green-building-01.jpg)

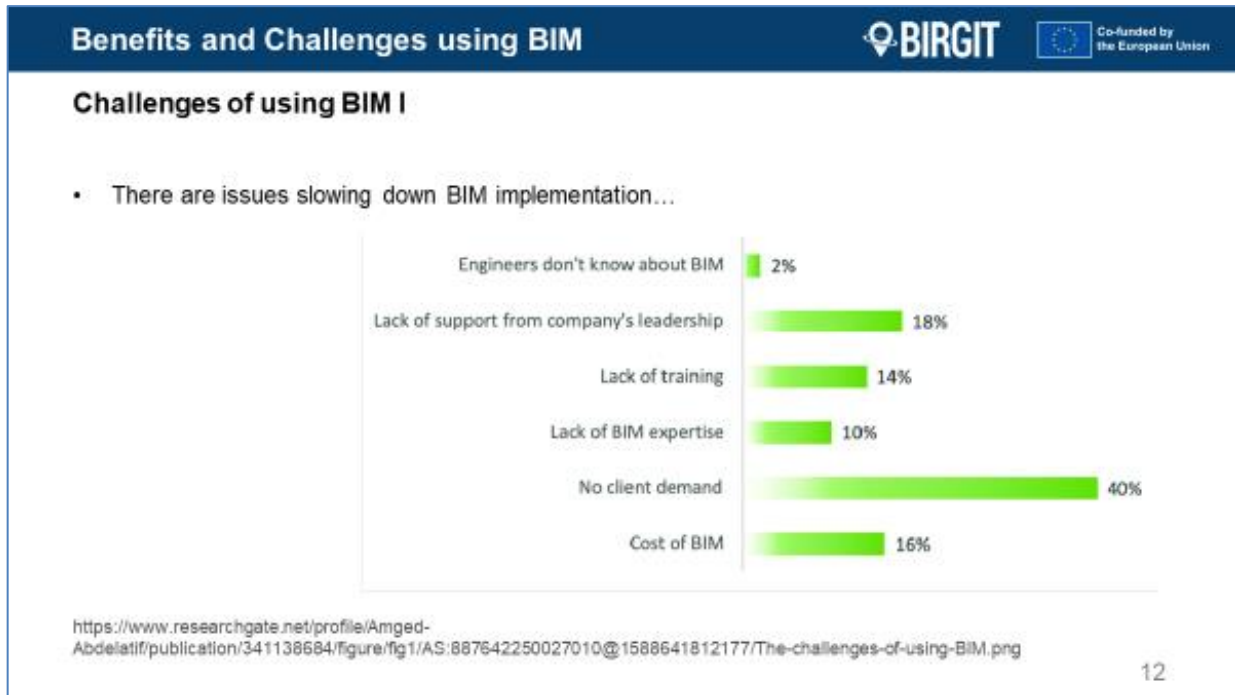
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Thanks to the benefits named above, BIM can improve building environmental performance in many ways. It can include both energy and material savings. That leads to reduction of carbon emissions to the atmosphere e.g. by:

- working on the basis of the central model reduces the consumption of paper, which translates into lower CO2 emissions
- considering whether there is an alternative material with similar properties with low CO2 emission factor, or locally produced instead of imported
- optimization of on-site logistics to reduce transport
- optimizing design to local settings, like shade, wind effect for best heating and cooling performance and thus energy savings
- counting exact need of materials, which also reduces waste production
- identifying possibilities of material reuse
- improved communication with environmental professionals

To sum up the BIM benefits, the proper application of BIM means that in the long run, with the same or even less public spending, more facilities can be built and maintained, the risk of budget overruns will be reduced, the projects will be more transparent and buildings more sustainable.

## Challenges of using BIM I

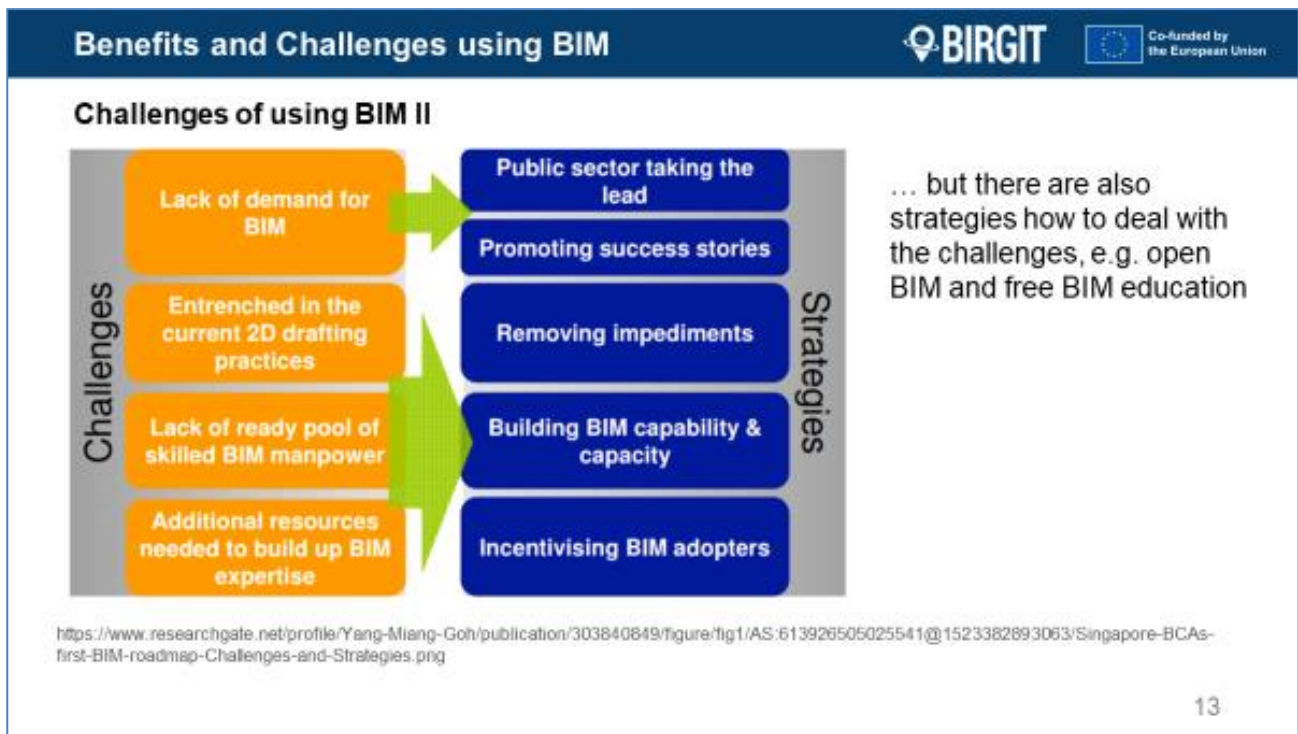


BIM has brought significant improvements to the AEC industries. However, there are also several issues associated with its introduction and implementation. Here are some of them:

- **Resistance to change:** The adoption of BIM requires a significant change in the way professionals work, which can lead to resistance among employees and organizations.
- **High initial costs:** significant investment in software, hardware, and training, which can be a barrier to entry for smaller firms.
- **Interoperability issues:** BIM models must be able to work seamlessly with other software and applications, which can be challenging due to the lack of standardization. Despite efforts to create industry-wide standards for BIM, there is still no universal agreement on what these standards should be.



## Challenges of using BIM II



**Data quality:** BIM models rely on accurate and complete data, and data quality can be compromised if there are errors in the input data or inconsistencies in data management.

**Legal and contractual issues:** these can arise among organisations, such as intellectual property rights and liability for errors and omissions.

**Training and education:** BIM requires specialized skills and knowledge, and there is a shortage of trained professionals in the industry.

If you would like to learn more about expert opinion, read <https://bimcorner.com/what-is-the-biggest-challenge-in-bim-asking-experts/>.

Overall, the benefits of BIM outweigh the challenges associated with its implementation. However, it is important to be aware of them and take steps to address them.