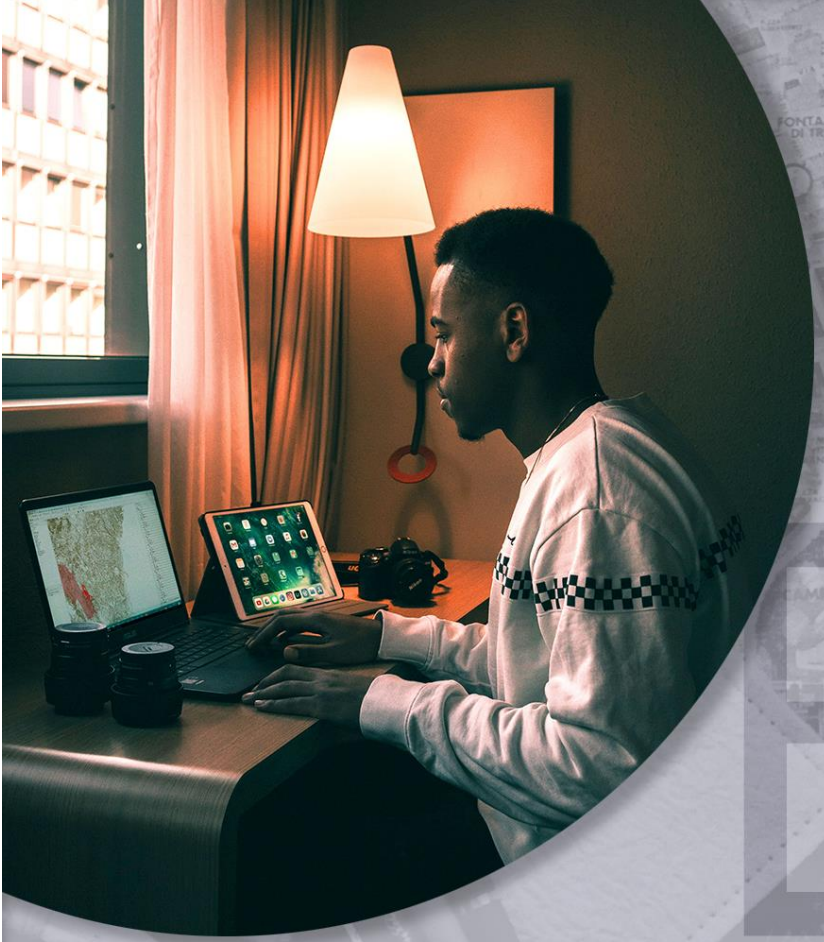

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Fundamentals of BIM

April 2025 V2.0

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Block 1 – Lecture 1.1

Fundamentals of BIM

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Learning outcomes

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

- Define the main concepts of Building Information Modeling.
- Identify the benefits of BIM for different stakeholders.
- Recognize the different stages of the BIM lifecycle.
- Describe the importance of BIM standards and best practices.

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What is BIM? I

- **BIM (Building Information Modeling)** is an integral digital process that encompasses the generation, management, and exchange of data about a built environment throughout its lifecycle.
- BIM facilitates the creation of a virtual 3D model that represents the physical and functional characteristics of the building or infrastructure.
- BIM empowers stakeholders to optimize the design, construction, operation, and maintenance of the built environment, leading to improved efficiency, sustainability, and overall project success.
- It facilitates collaborative communication and coordination among various disciplines involved, enabling informed decision-making.
- The continuous advancement of BIM technology is transforming the construction industry, driving innovation and shaping the future of the built environment.

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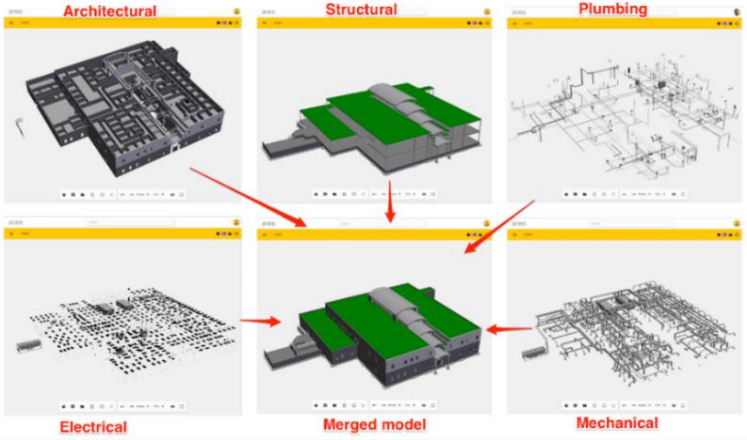
What is BIM? II

As can be seen in the next figure, when working with BIM the models are merged and referenced in the same system. This improve the design and production coordination tasks.



Working with BIM therefore implies permanent coordination, communication and collaboration, which results in the following advantages:

- Integration of information in a single model with information from all phases: planning, design and management.
- Collaboration: All actors share the same model at all stages.
- Easier and faster communication: insertion of common objects known by all parties involved.

According to **EN ISO 19650**, BIM is defined as the use of a shared digital representation of a built asset to facilitate the processes of design, construction and operation of the asset and to provide a reliable basis for decision making.

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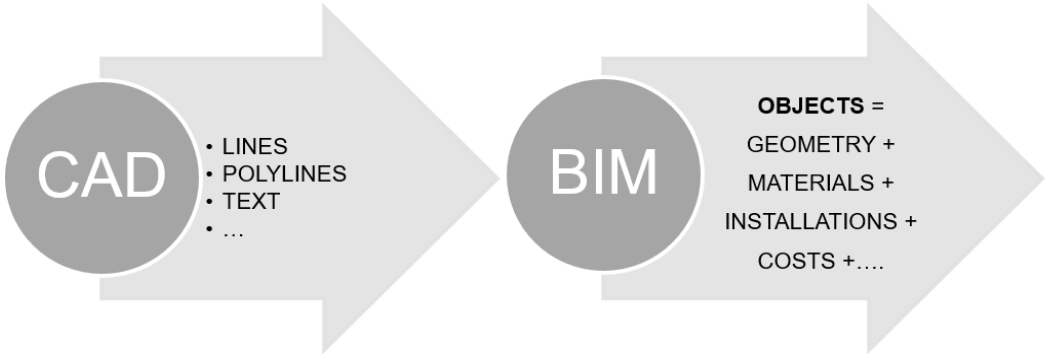
Brief History of BIM I

- Until the 1970s: there was only Computer Aided Design. From that decade on, CAD and BIM coexisted.

- CAD is a small part of the BIM system, related to the graphic definition and some characteristics of the elements that make up each objects in BIM



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Brief History of BIM II

- The main milestones in the history of BIM are:
  - 1975: The first paper on BIM is published, by **Professor Charles (Chuck) M. Eastman,** United States (US).
  - 1984: ISO STEP is created, regulating the Standard form of the Data Model for the exchange of products. **ArchiCAD** (Graphisoft, HQ), first BIM program (Hungary).
  - 1996: **International Alliance for Interoperability (IAI)** industries begins operations, advising on the development of integrated applications, United States.
  - 2000: **Revit 1.0. version** is released (Autodesk, Inc), United States.
  - 2002: The **first integrated BIM project** is created in Finland.
  - 2006: The **first Integrated Project Delivery** is carried out in the United States.
  - 2007: **Guidelines** on how to carry out a BIM project are created in the US (General Services Administration) and Finland (Senate Properties).
  - 2010: The United Kingdom (UK) Government announces the requirements for implementation.
  - 2012: Finland publishes common national BIM requirements.
  - 2015: Countries such as Spain have adopted roadmaps for implementation.
  - 2016: UK makes implementation of BIM methodology mandatory for public works projects.
  - 2018: Mandatory use of BIM in Spain in Public Building Tender projects.

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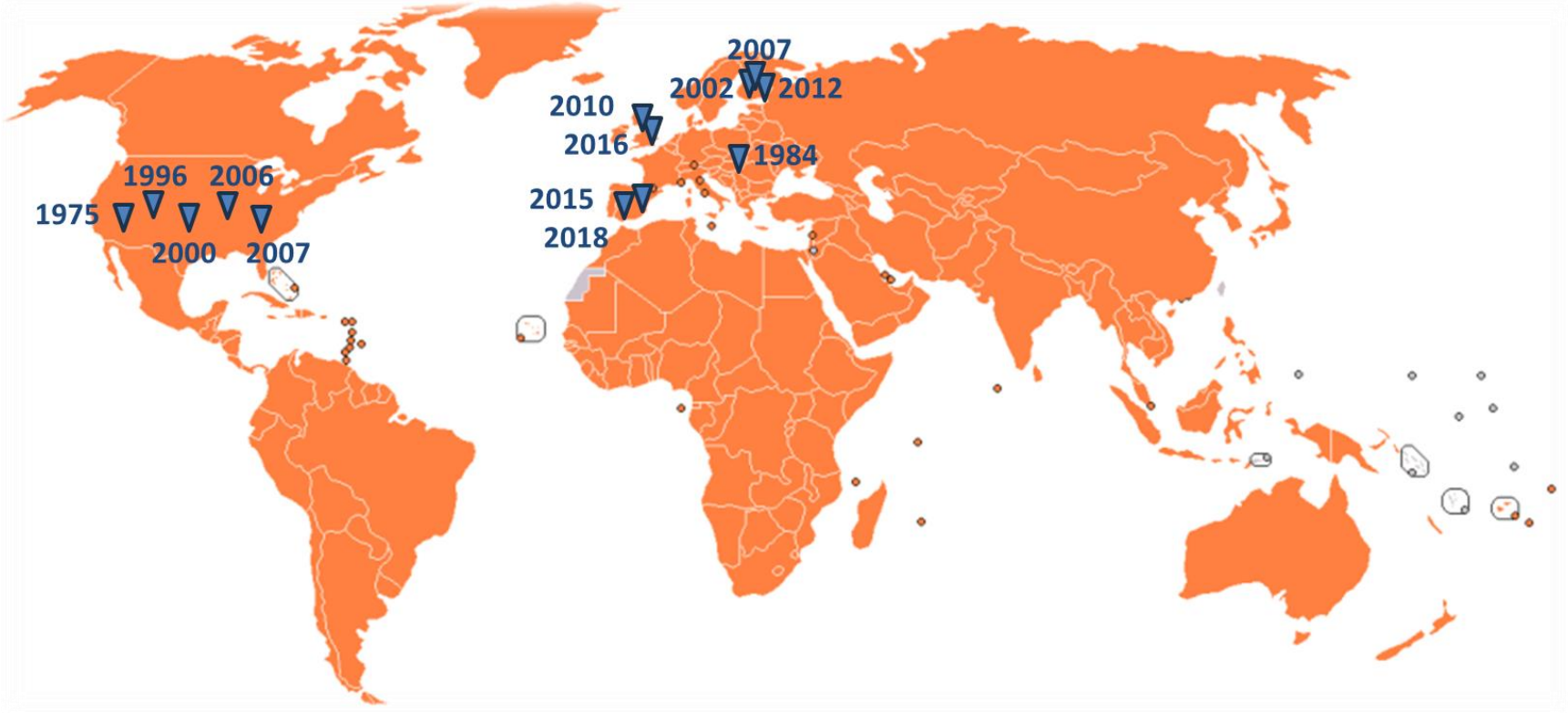
Brief History of BIM III



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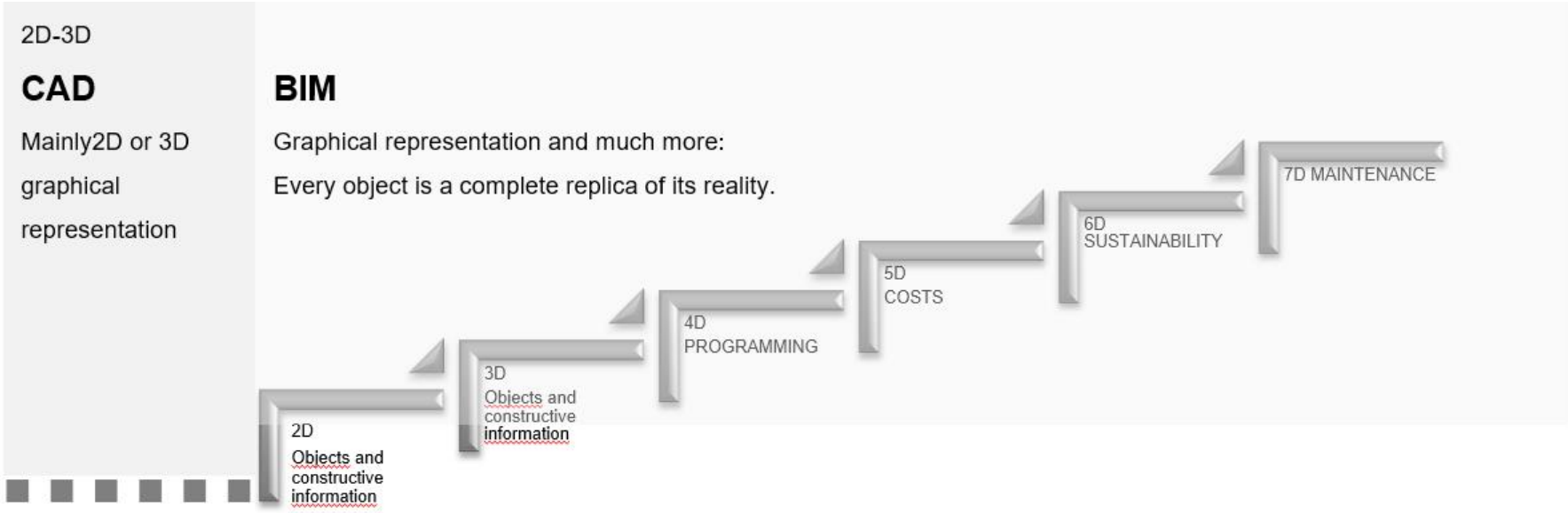
Transition from CAD to BIM



The process of Building Information Modeling involves designing, constructing, and maintaining buildings digitally. Therefore, throughout the lifecycle of building construction modelling, the need for data and information increases, working with more and more dimensions (data) simultaneously.

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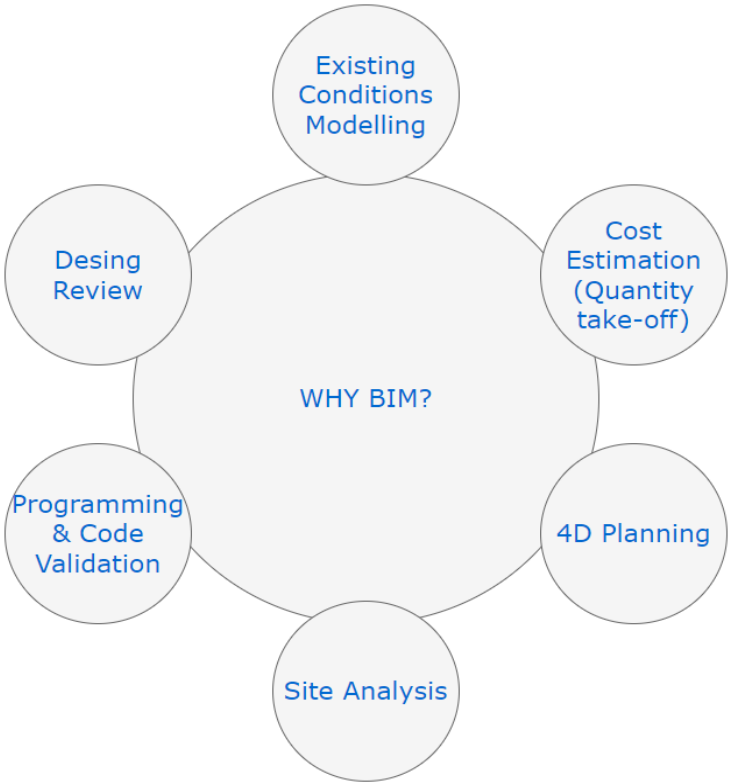
Identification of BIM uses: AEC(OO) Industry

- Building Information Modeling makes it easier:

  .

  - Information is captured, collected and organized easily
  - Generate information about the installation
  - Analysis of the elements to better understand them.
  - Communication, visualization, drawing, presenting and sharing information.
  - The information done for different people is monitored and controlled or assembled easily.

The variety of needs to which BIM responds makes its uses very varied, so, its development requires the need for the collaboration of different specialists in the sector.



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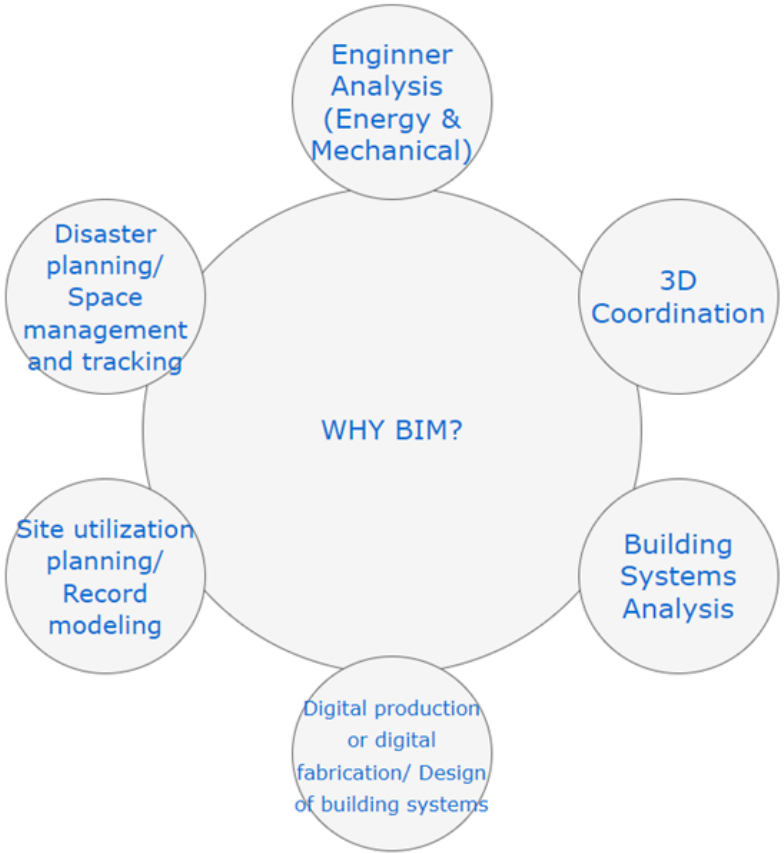
AEC(OO) Industry

The AECOO sector is comprised of the Architecture, Engineering and Construction companies, Owner Operator and other users related to Building Information Modeling. Companies that are the main users and collaborators in BIM, as the use of this model helps them to carry out their work more efficiently.

In the picture we can see examples of activities that can be performed easier and with a higher quality using BIM



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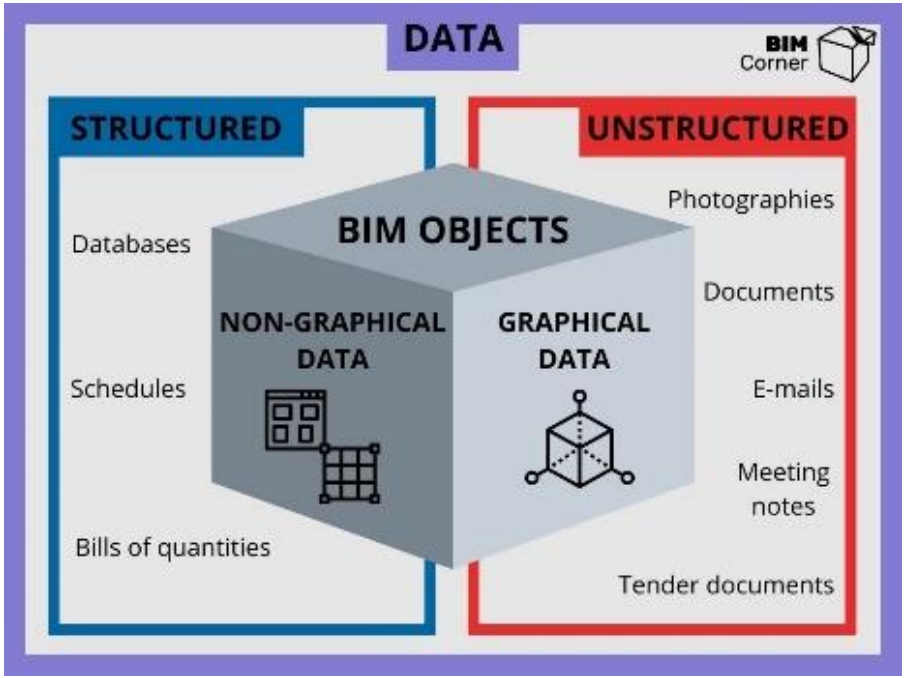
Data management in BIM



BIM data mangement. Source: BIN Corner who referes to KF-DATA In BIM Infographics

Data management in BIM is the process of organizing, storing and sharing data related to a BIM project.

This process ensures data integrity, accessibility, and usability throughout the project lifecycle.

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Data included in BIM projects

The data included commonly in a BIM project, can be categorized as either structured or unstructured data:

- Structured data is highly organized and adheres to a predefined format, such as spreadsheets, databases, and construction drawings.
- Unstructured data lacks a predefined format and is often text-heavy, such as emails, notes, tender documents, and maintenance records.

BIM systems are designed to manage and integrate both structured and unstructured data, enabling a holistic understanding of the project.

All this information will be used to manage the building throughout the project's life cycle, encompassing their different dimensions.

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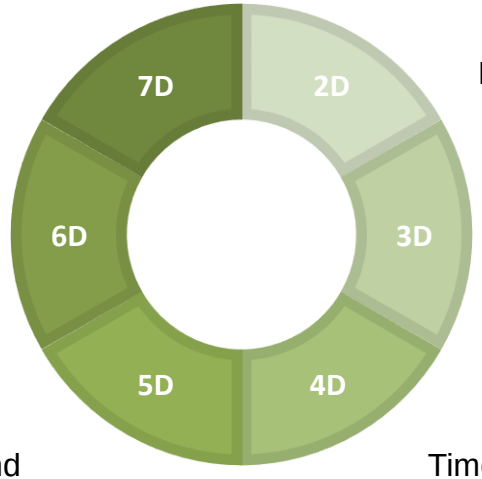
Data management in BIM: BIM dimensions

All aspects and information of the same type involved in the digitization process of a building.
Caution ! : At each phase of the BIM lifecycle, information corresponding to various dimensions of the model.

7D or Maintenance:
Operation and management of facilities

6D or Sustainability:
analysis of energy consumption, cost-effectiveness



2D:
Representation of objects in 2D

3D:
3D modeling of elements, with their graphical representation and associated information

5D or Costs:
Analysis of budgets and construction costs; optimization

4D or Scheduling:
Time schedules, time analysis and simulations

Note: Nowadays, we are starting to talk about a classification with three additional dimensions: 8D (construction safety), 9D (lossless construction) and 10D (construction industrialization). It will be discussed with more detail in lecture 3

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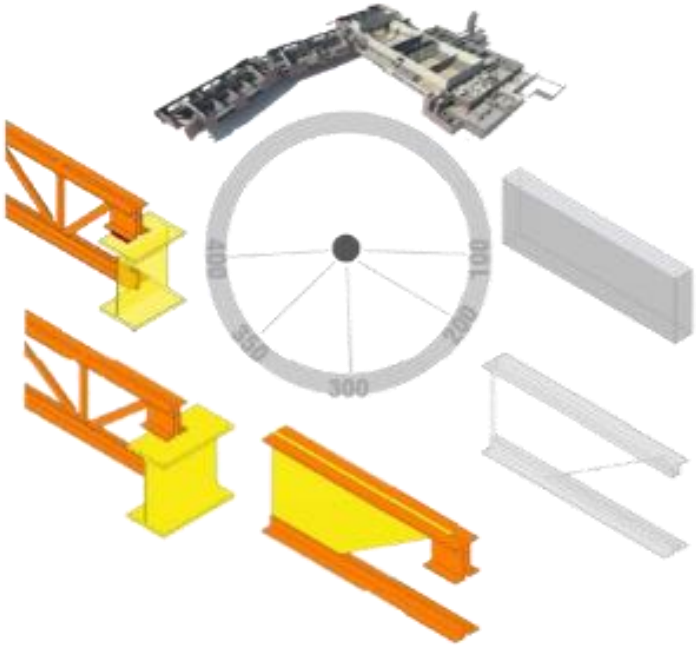
Level of Development

The Level of Development (LOD), defines the level of detail with which a graphic element is represented on a scale (which varies according to the reference legislation) and it shows the different stages of its development.

LOD = LOG (Level of Geometry) + LOI (Level of Information)

- It is enriched with details as the BIM project progresses
- It evolves from a simple initial concept to an executable model.

Note that a high LOD does not always correspond to a high level of project development.



LOD in different stages.

Source: BIM Forum

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Data management in BIM_BIM LOD: Standards AIA

The American Institute of Architects (AIA) defines a standard LOD framework to facilitate communication and data exchange between the various stakeholders.

Level Of Developement. Source: bibLus

Established levels of development are:

- LOD 100: Symbolic representation
- LOD 200 Generic system
- LOD 300 Specific system
- LOD 400 Manufacturing
- LOD 500 Verified representation - As built

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BIM Standard ISO 19650

To tackle challenges and improve project outcomes, the International Organization for Standardization (ISO) developed ISO 19650. This globally recognized standard provides comprehensive guidance on managing information throughout the entire lifecycle of a construction project, from inception to operation.

- **Collaboration Management**
- **Efficiency**
- **Risk Management**
- **Quality**
- **Sustainability**

Source: BibLusBIM

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Thank you for your attention.

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