



Course: BIM introduction. Block 1: BIM definition. Lecture 3.1

Level of Development and 3D - 10D BIM

Lecture Notes

Author(s)/Organisation(s):

Ariana Kubart (Ocellus)

License



<https://creativecommons.org/licenses/by-sa/4.0/>

Version

Version 1.0

Date: March 2024

Learning outcomes

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

- Explain role of different Levels of Detail in BIM
- Name diverse kinds of information which can be provided by BIM
- Relate the Level of Development and the 3D-10D concept to asset life-cycle



Summary

Lecture 1.3. introduces concept of “Level of Development” in BIM process and explain how it changes during the asset life-cycle. Then, it opens up what diverse kind of information can be provided by BIM within the 3D-10D dimension of the process and how it can enhance issue solutions in the AEC industry.

Expected competences when entering the lecture

- No specific pre-requisites required.

Expected workload

11 slides with course learning content, 2 hours

Disclaimer

The European Commission support for the production of this publication does not constitute endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.



Revision History:

Revision	Date	Author(s)	Status	Description
0.1	2024-01-20	A. Kubart	Draft	First draft
0.2	2024-02-26	A. Kubart	Draft	Second draft after review by R. Molina
1.0	2024-03-14	A. Kubart	Published	Edited by M. Morbidini



Content of the lecture:

Level of Development in BIM	5
LoD levels	6
LoD Levels – example	7
Elements in model have diverse LOD	8
LOD in Building Lifecycle	9
BIM Dimensions 3D-10D	10
BIM Dimensions 3D-10D II	11
3D - 4D Modelling	12
5D BIM	14
6D – 8D BIM	15
9D – 10D BIM	16

Level of Development in BIM

LoD and 3D-10D BIM

Level of Development in BIM



LOD 200 LOD 300 LOD 350 LOD 400

<https://i3.wp.com/mxfiles.com/wp-content/uploads/2023/07/image3.png?media=768%2C283&ssl=1>

LoD – Level of Development, or even Level of Detail

Describes not only geometric features, but all BIM content for each element

4

We know already that there are several discipline-specific BIM models existing simultaneously, before they are merged to the integrated model. The individual models are characterised by Level of Development, LOD.

LOD is an industry standard, which determines the quality of a model.

LOD was originally named “Level of Detail”. Later on, the system has been standardized and renamed to “Level of Development”. The change of name emphasised the importance of this not just being about geometric features but about all the BIM content for each of the elements.

Level of Development is defined by LOD “numbers” like LOD 100, LOD 200 or LOD 300.

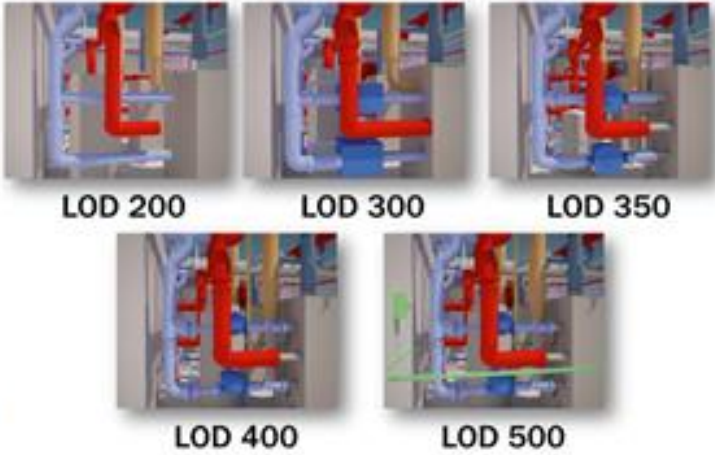
LoD levels

LoD and 3D-10D BIM

LoD Levels

LOD levels usually increase during the BIM process:

- LOD 100 - Concept Design
- LOD 200 - Schematic Design
- LOD 300 - Detailed Design
- LOD 350 - Construction Documentation
- LOD 400 - Fabrication & Assembly
- LOD 500 - As-Built



A piping project at various LOD (Levels of Development) levels
Source: <https://lanmarservices.com/2014/05/14/lo-d-in-scan-to-bim/>

LOD levels usually increase during the BIM process, from initial LoD 100 to final LoD 500. These mean:

- LOD 100 - Concept Design
- LOD 200 - Schematic Design
- LOD 300 - Detailed Design
- LOD 350 - Construction Documentation
- LOD 400 - Fabrication & Assembly
- LOD 500 - As-Built

LoD Levels – example

LoD and 3D-10D BIM

Co-funded by the European Union

LoD Level - example

LoD for a chair:

LOD 100 = there is a chair

LOD 200 = a chair with space requirement

LOD 300 = a chair with arm rests and wheels

LOD 400 = manufacturer and model number

LOD 500 = manufacturer and model number, supplier, date purchased

LOD 100 <small>(Only data in red is useable)</small>	LOD 200	LOD 300	LOD 400	LOD 500
Concept (Presentation)	Design Development	Documentation	Construction	Facilities Management
DESCRIPTION: Office Chair Arms, Wheels WIDTH: 700 DEPTH: 450 HEIGHT: 1100 MANUFACTURER: Hermann Miller MODEL: Mirra LOD: 100	DESCRIPTION: Office Chair Arms, Wheels WIDTH: 700 DEPTH: 450 HEIGHT: 1100 MANUFACTURER: Hermann Miller MODEL: Mirra LOD: 200	DESCRIPTION: Office Chair Arms, Wheels WIDTH: 700 DEPTH: 450 HEIGHT: 1100 MANUFACTURER: Hermann Miller MODEL: Mirra LOD: 300	DESCRIPTION: Office Chair Arms, Wheels WIDTH: 685 DEPTH: 430 HEIGHT: 1085 MANUFACTURER: Hermann Miller MODEL: Mirra LOD: 400	DESCRIPTION: Office Chair Arms, Wheels WIDTH: 685 DEPTH: 430 HEIGHT: 1085 MANUFACTURER: Hermann Miller MODEL: Mirra PURCHASE DATE: 01/07/2015

<http://wordpress.archigraphic.de/en/wp-content/uploads/sites/5/2015/07/Level-of-Development-ENG-1024x724.png>

Therefore LOD levels for a chair might be:

LOD 100 = there is a chair

LOD 200 = there is a chair that has nominal space requirement of 500x500

LOD 300 = there is a chair with arm rests and wheels

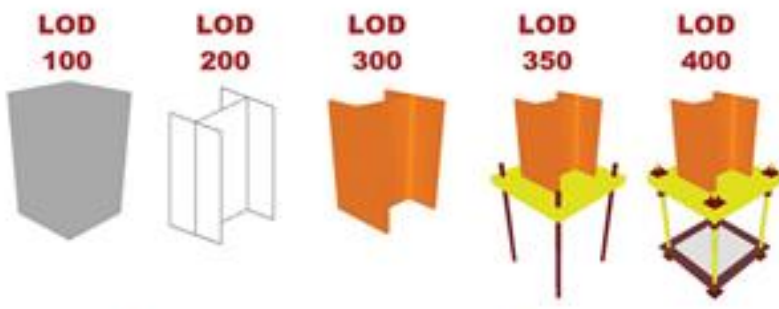
LOD 400 = manufacturer and model number.

LOD 500 = manufacturer and model number, supplier, date purchased

Elements in model have diverse LOD

LoD and 3D-10D BIM

Diverse LoD in the same model



LOD 100 **LOD 200** **LOD 300** **LOD 350** **LOD 400**

- LoD is a measure of progress in %
- LOD 500 is 100%, then LOD 100 = 20%, LOD 200 = 40% etc.
- At any stage the model will contain elements in diverse LoDs

BIMForum Original Content – BIM Forum

7

LOD can be seen as a measure of progress. At LOD 100 there is obviously more work to do to reach LOD 300. In that sense it is like the traditional percentage complete of drawings. Assuming LOD 500 is 100%, then LOD 100 = 20%, LOD 200 = 40%, LOD 300 = 60% etc.

What is important, it is the fact that there is no single LOD classification for the whole model. It assumes that at any stage the model will contain elements and systems at different levels of development

It is more useful to know that on a plan the floor is 60% complete (LOD 300), the walls are 50% complete (LOD 250) and the service ducts are 40% complete (LOD 200), rather than the whole drawing is 50% complete (the average of all elements).

This LoD classification was created by BIM Forum – you can find detailed specification about it here: [LOD specification](#).

LOD in Building Lifecycle

LoD and 3D-10D BIM

LoD in Building Lifecycle

Different needs for BIM information during building lifecycle

= different BIM models in time

In reality, not always done until LoD 500

Though, LoD 500 BIM model for Facility Management is highly important

www.tejy.com

<https://www.tejy.com/wp-content/uploads/2021/11/Level-of-Development-LOD-Tejy-inc-1-1024x627.jpg>



There will be a lot of information generated during the lifecycle of the design and construction process. Owners should focus on a minimum set of info that should be present and validated during handover (e.g. correct positioning, correct level of detail for geometry, core product data and linked O&M instructions.) The main takeaway is for both the project and the owner to understand the difference between a design intent model, a construction model and a facilities management model.

Currently most BIM model elements “end” their lifecycle at design intent. They are used to automate the creation of design documents. Generic object are not replaced by manufacturers objects and manufacturer's product data are not linked to the model elements. Contractors do not improve the models to the LOD 400 level. For us it is important to point out that you can generate LOD 500 models (models for facility management) without evolving the models to the full LOD 400 spec.



BIM Dimensions 3D-10D

LoD and 3D-10D BIM

 Co-funded by the European Union

BIM Dimensions 3D – 10D

BIM model = not only 3D geometry, even properties and much of additional information

Analysis for multiple purposes can be done

These analyses:

- increases the value of the data (not possible in CAD)
- can be performed already in design phase = clear picture and less error in early stages

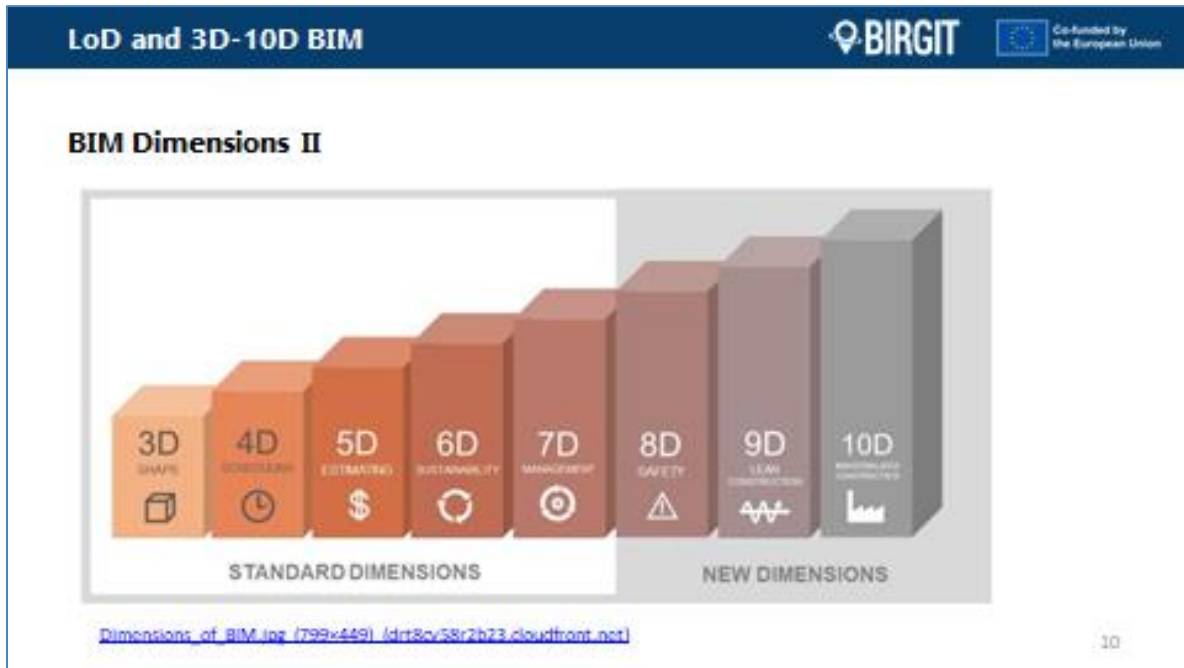
<https://bibli.usaccasoftware.com/en/wp-content/uploads/sites/2/2018/04/dimensions-of-BIM-2.jpg>

Besides the 3D geometry, any kind of information can be associated with a BIM model. The model becomes a data hub.

This information can be used not only to model what will be built, but also to e.g. visualize the construction, how long it will take, optimize logistics and security on the construction site, count the material use, costs and environmental impacts etc.

All these analyses (for multiple purposes) increase the value of the data and are referred as BIM dimensions, from 2D to 7D and recently up to 10D. What is the best, it is possible to model everything already in the design phase, when it is easiest and most cost effective to explore design alternatives.

BIM Dimensions 3D-10D II



In short, these dimensions are:

- 3D** the geometrical information itself
- 4D** project time planning and construction sequencing
- 5D** quantity and resource tracking with cost analysis
- 6D** structural and energy performance, environmental, economic and social sustainability impact
- 7D** operations and maintenance throughout the building's lifecycle
- 8D** health safety during construction
- 9D** efficient management and improved coordination to well-informed decisions
- 10D** construction industrialization to maximize productivity

<https://biblus.accasoftware.com/en/bim-dimensions/>

3D - 4D Modelling

LoD and 3D-10D BIM

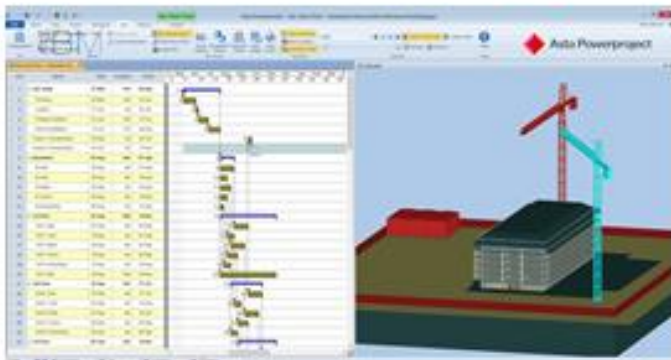
3D and 4D BIM modelling

3D

- the first step
- geometry enriched with properties

4D

- time schedule and simulations
- sequence and duration of activities
- visualisation of the construction for stakeholders



[https://www.thebim.com/assets/images/Asta+Powerproject+\(4D+BIM\)+on+The+BIM.png?Action=thumbnail&algorithm=fill_proportional&width=754](https://www.thebim.com/assets/images/Asta+Powerproject+(4D+BIM)+on+The+BIM.png?Action=thumbnail&algorithm=fill_proportional&width=754)

11

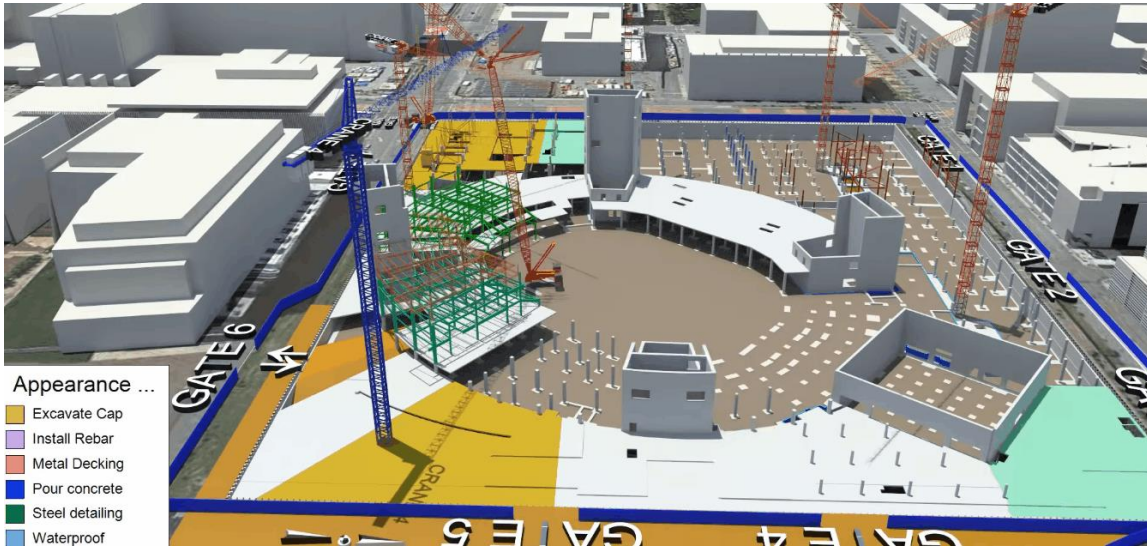
3D modelling is the first step and a key in implementing BIM. The 3D graphical model should be enriched with all other data for next BIM dimensions. The 2D views can be automatically exported from the 3D model.

The 4D focuses on planning. It aims to establish schedule, simulates construction activities, their sequences and duration, and evaluates different alternatives / scenarios.

By doing so, the required supply of materials, equipment and human resources can be defined. Each individual activity gets a date to begin and a date to end. This can be represented a Gantt chart, where horizontal axis corresponds to the time and vertical axis represents the construction activities.

The 4D modelling is also a powerful visualization and communication tool. This is best documented by an example (go to the link):

Usage of Synchro software 4D simulation - <https://www.synchro ltd.com/>



5D BIM

LoD and 3D-10D BIM

5D BIM - Budget

- Automatic estimation of costs
- Comparing alternatives
- The cheapest not always the best option



Up: [5D BIM SERVICES.png \(479x519\)](#)
([se-bimcoordination.com](#))
Left: [maxresdefault.jpg \(1280x720\)](#) ([yiting.com](#))

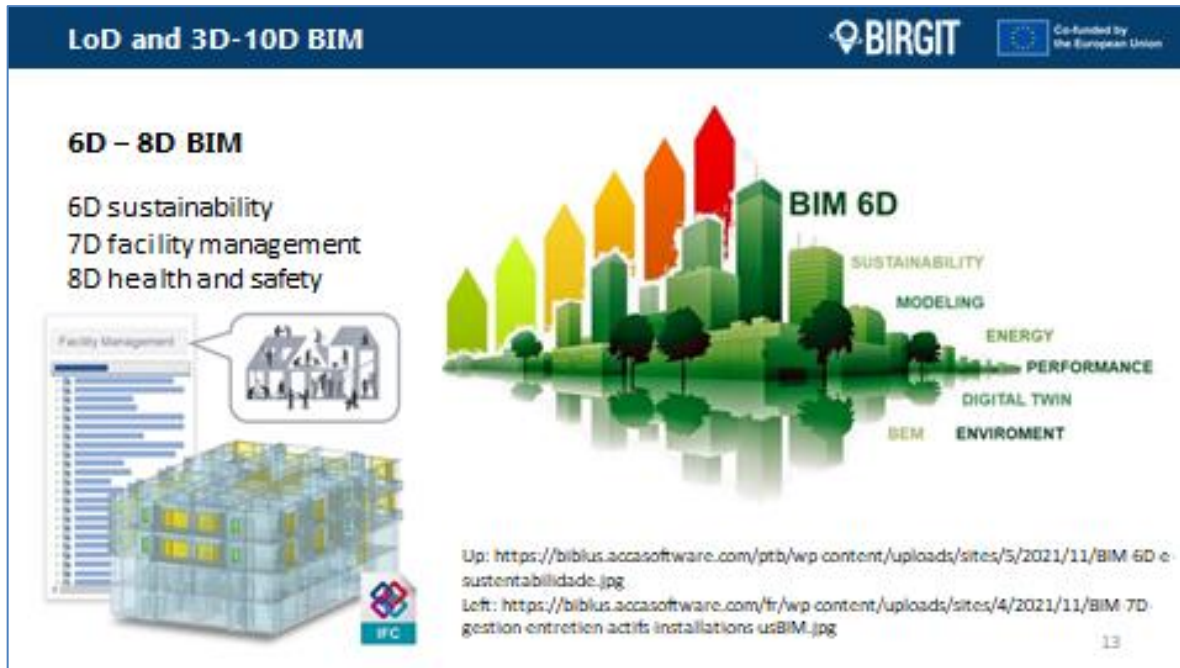
12

5D is about resource tracking. And knowing the amounts of needed resources, it is possible to estimate costs and create budgets. BIM software calculates the costs automatically, which makes possible to easily compare the alternatives.

Of course that prices may change in future, causing budget overruns. That is also why the cost estimate should be updated time to time. But in any case, 5D will increase accuracy and transparency of tenders and of the construction itself.

Speaking about the tenders, we should note that the cheapest variant may not always be the most economical. BIM model helps even to consider e.g. quality and lifespan of materials and products used in the building. Excessive reducing of costs would also decrease the quality of work and increase reparation and renovation costs in the future.

6D – 8D BIM



The quality issues take us to the 6D dimension, the environmental sustainability. We spoke already about ways how BIM can help to reduce environmental impacts (see Lecture 1.2.). 6D even includes the Environmental Impact Assessment, EIA, of the project.

But BIM has potential to improve even social sustainability, in meaning of increased human well-being with proper society planning.

7D BIM moves us from design and construction to the operation stages. The maintenance and renovation need to keep track of all relevant data related to components, specifications, suppliers, installation manuals, warranties, etc. In the best case, this information helps to optimise FM costs in the long term, through the whole LC.

8D BIM is the dimension that adds safety information to the BIM model. It allows to predict risks during the construction process and to identify measures to improve safety and to prevent accidents.

8D BIM thus overlaps with term EHS, which stands for "Environment, Health, and Safety". It is a set of practices that focus on protecting workers and the environment from harm in industries working with hazardous materials or in dangerous conditions. "EHS construction" may refer to a contractor that specializes in following EHS protocols and regulations in all of their construction projects.

9D – 10D BIM

LoD and 3D-10D BIM

9D – 10D BIM

9D

- Lean construction
- Project management
- Construction simulations

10D

- Construction industrialisation
- Supply chain management
- Lifecycle & digital twin

[Dimensions BIM 9D lean construction usBIM 705x512.jpg \(705x512\) \(accasoftware.com\)](#)

14

9D BIM is an emerging concept that aims to improve coordination, efficiency, and communication among stakeholders throughout the entire. It should include all the aspects of 3D to 8D and adds legal and regulatory-related data, such as compliance requirements or building codes. It is also referred as “lean construction” and hopes in better-informed decisions and to keep the project on schedule and within budget.

9D includes also efficient management of resources by their constant monitoring, in order to their best possible use and to waste reduction.

10D BIM aim to industrialize the constructions and to integrate the new, mainly digital, technologies, including BIM itself. Another aim is to use off-site prefabrication, followed by assembling of the components on the construction site. This should result in further increasing of efficiency and productivity of the construction process.