



Course: BIM introduction. Block 2: Working with BIM data. Lecture 2.3

BIM coordination

Lecture Notes

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Learning outcomes

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

- Explain the role of discipline-specific BIM models
- Understand why the specific models are merged to final model
- Assess the main advantages of Common Data Environment
- Describe the crucial steps in BIM implementation and how it relates to BIM maturity level



Summary

This lecture opens an important topic of the BIM process, i.e. its coordination. It starts explaining how individual disciplines design their specific models, which are then merged together to an interdisciplinary model. The student gets understanding why, how and by whom it is done. Further, the lecture explains how the data and models are shared for successful access and communication within projects many stakeholders. Lecture's latest topic deals with issues slowing the process of BIM implementation and introduces BIM maturity level, in dependence how many of the issues have been solved.

Expected competences when entering the lecture

- No specific pre-requisites required.
- Attend the first block of the course, BIM Definition

Expected Workload

18 slides with course learning content, 3 hours

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Revision	Date	Author(s)	Status	Description
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BIM is a process

2.3 BIM Coordination

BIM is a process

- BIM is long-term process, not just a 3D model of a building
- Many models are created during time in the BIM process
- Many participants and stakeholders are involved

Appointing Party



Client

Lead Appointed Party



Main Contractor /
Builder

Appointed Parties



Architect

Structural

MEP

<https://bimimplementer.wordpress.com/2021/03/13/appointing-appointed-and-lead-appointed-which-party-am-i/>

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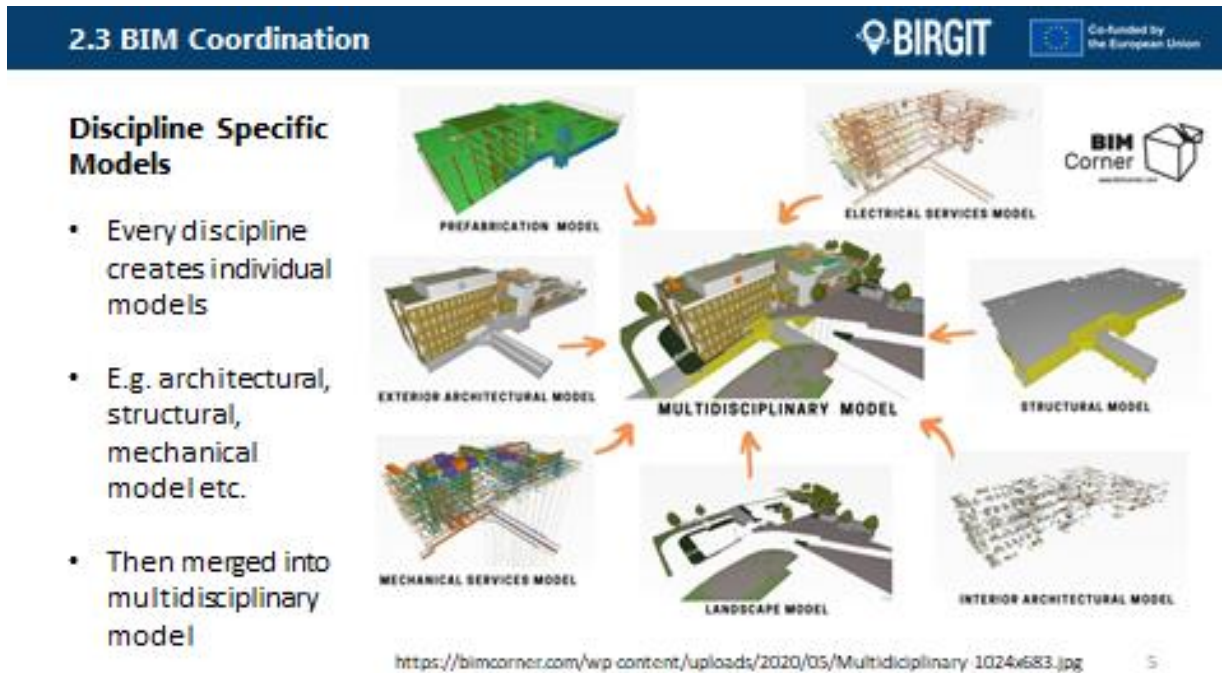
We have already specified that BIM is not a single 3D model, but that it is a process continuing through the whole Life Cycle, let's say 100 years.

There are many specialists from various fields involved in the BIM projects.

We have already heard about the Client, in other contexts called Customer, Owner or Appointing Party. The client selects the most suitable bid during the tender (see also Lecture 2.2) and sign-up a contract with the main Contractor, also called Builder or Lead Appointed Party.

The main Contractor, in turn, usually employs Subcontractors, or Appointed Parties, even called Task Teams, responsible for performing a specific task. These can be e.g. architects and different engineers. The contractors find suppliers of diverse materials and products needed for the construction.

Discipline-specific and merged model



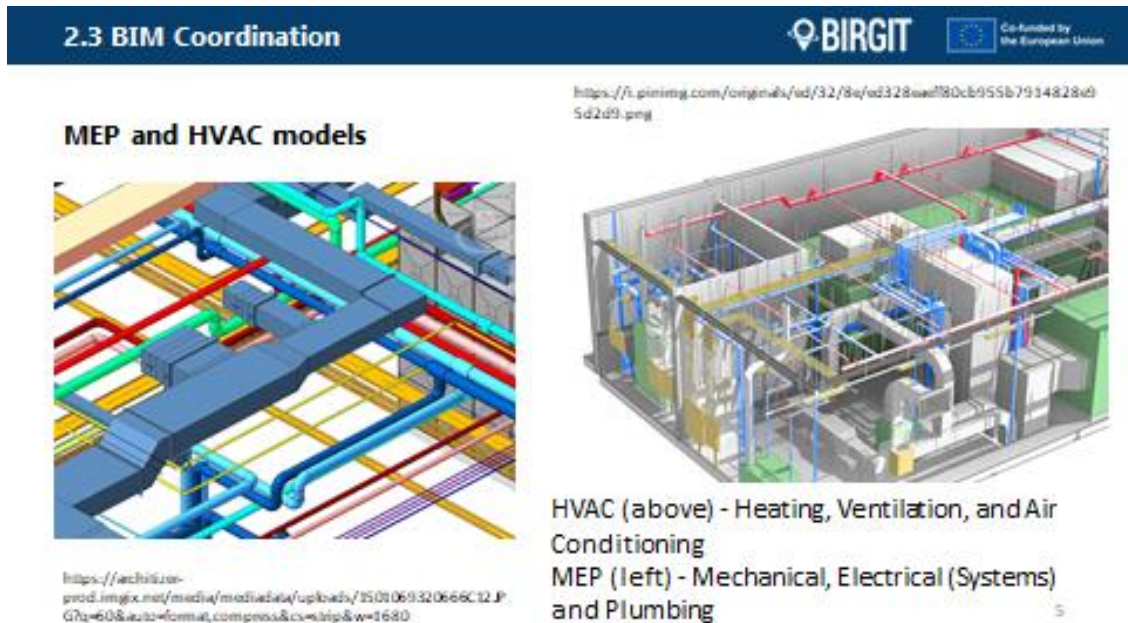
In the design phase of a BIM process, each discipline team usually creates its own model, implementing its design aspect and using its own BIM authoring software.

In other words, there will be individual models of building architecture, structure, ventilation, electricity and so on.

When ready, the discipline-specific models are integrated into the overall BIM model, also called merged or multidisciplinary model

This merged model covers all aspects of the building (i.e. structural, architectural, MEP, HVAC, energy performance, etc.), which allows quality checks and efficient coordination of the involved teams, i.e. the major BIM benefits.

MEP and HVAC models



There are two important abbreviations to be aware of: MEP and HVAC.

MEP stands for Mechanical, Electrical (Systems) and Plumbing. This 3D model is purely focussed on the engineering aspects such as the location of equipment, piping, ductwork, electrical wiring, and other components.

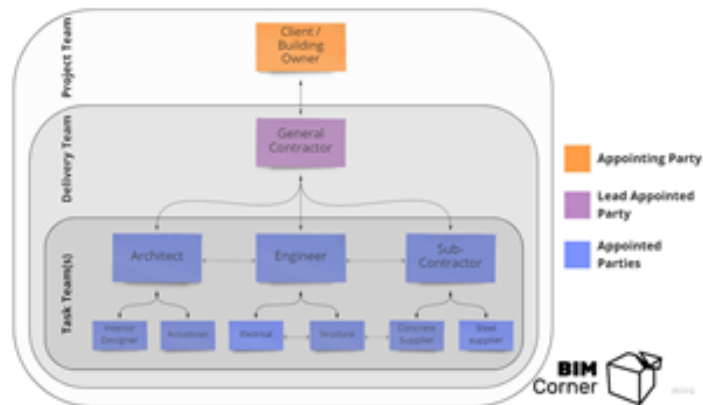
HVAC stands for Heating, Ventilation, and Air Conditioning, i.e. the automation system which is used for handling air quality and thermal comfort. These systems generally have three major elements: a heating unit, cooling unit, and duct to move the air, and are essential in all public and industrial buildings.

BIM Stakeholders

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BIM Stakeholders

- Several equivalent names exist on each level
- ISO 19650 terms try to unify these names
- Task Teams (Appointed Parties) are coordinated by Delivery Team (Lead Appointed Party, General Contractor)



<https://bimcorner.com/iso-19650-terms-explained-in-this-simple-way/>

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The various names for every stakeholder in the BIM process are used, but there is an ISO 19650 norm trying to unify them.

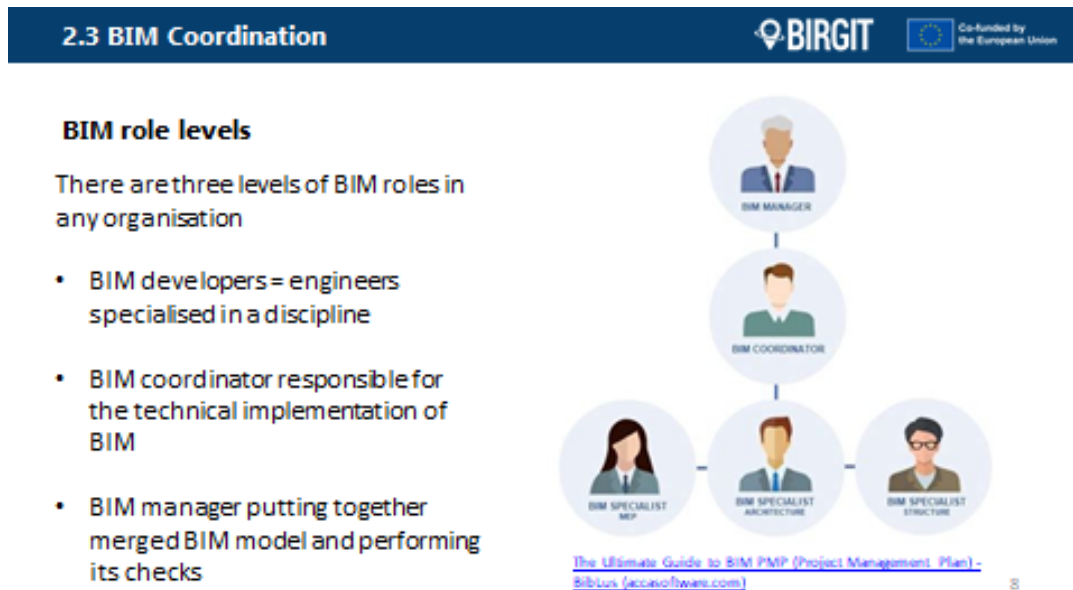
The Lead Appointed Party, also named Delivery Team and General Contractor, is assigned directly by the Project Owner. On big projects, it assigns tasks further to its appointed parties. In other words, it is the main company responsible for the project design and construction.

Further, the Lead Appointed Party has numerous responsibilities. Here, we name some of the most important ones.

- Coordination and supervising of the Task Teams
- Establishing BIM Execution Plan, BEP
- Assigning own resources (people, processes and technology)
- Preparing contract documents for each Task Team
- Accounting that BIM meets the requirements of the Appointing Party



Levels of BIM roles in an organisation



In any contractor organisation, there are basically three levels of BIM roles.

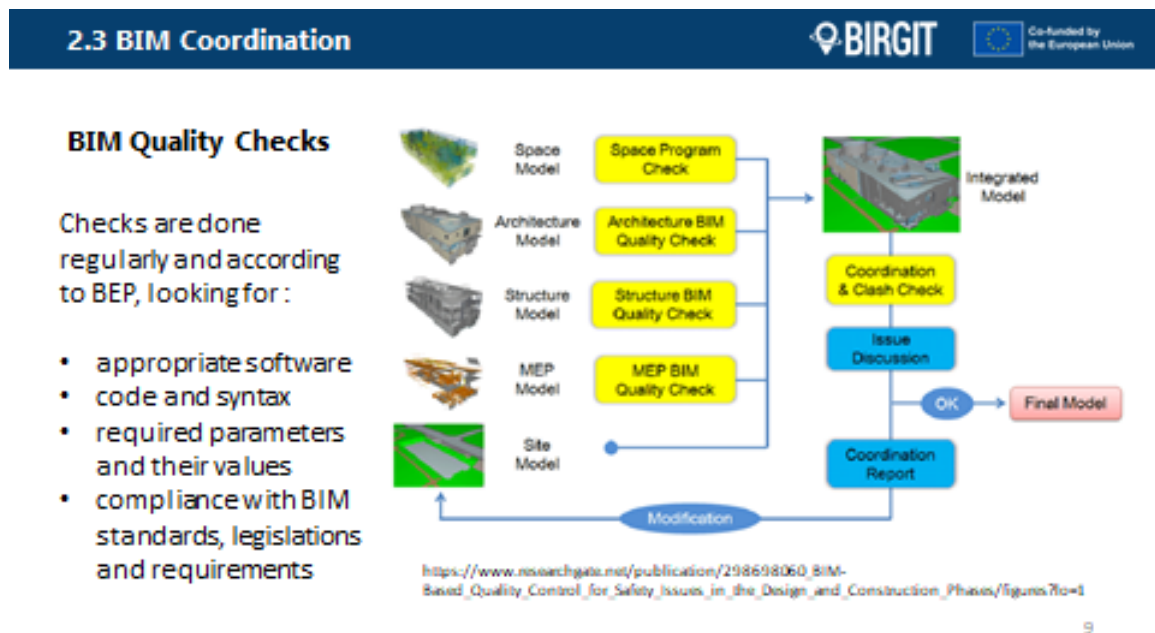
First, there are BIM developers, being specialists in their field. They are architects, designers, surveyors, engineers or technicians, all of them using diverse BIM software and tools. Each of them prepares a set drawings and models and is responsible for their quality. The specific requirements of any discipline are documented in the BEP.

Representatives of each project discipline may not modify models developed according to another specification. If it is needed to modify the other models, the changes are usually done by the original model author party. The discussion of changes is led by BIM coordinator, who is responsible for overseeing the technical implementation of BIM in the big project.

BIM Manager is then responsible for the transfer of the final submodels to the merged BIM model and performs final checks.

<https://biblus.accasoftware.com/en/bim-manager-bim-specialist-and-bim-coordinator-roles-and-responsibilities/>

The quality checks of BIM digital models



The quality checks are done regularly and according to BEP, usually every second week. First, they are done by visual viewing, followed by special software for the collision checks.



There are several aspects to be checked, not only the clash detection as usually mentioned (*more about clash detection below*). There are also non-graphical data checks and other aspects, e.g.:

- **to** ensure that the correct software is used, the files are properly named, the objectives of the project are met
- Appropriate code use and syntax checking
- presence or absence of required parameters and their values, if filled in and in given range
- **to** ensure compliance with BIM and CAD principles, standards, legislations and requirements

To know more, see nice description by BIM Corner: <https://bimcorner.com/a-few-words-about-rule-based-model-checking/>

Geometry checks and clash detection

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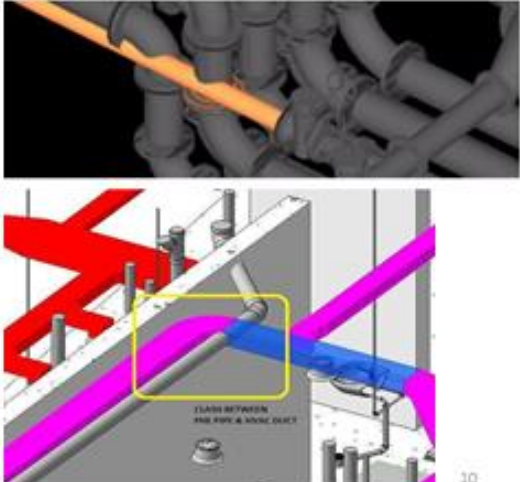


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Clash Detection

3D geometry checks of:

- Clashes
- Distances
- Duplicates
- Presence/ absence of building elements
- Overall design

Upper figure: [clash-detection.jpg \(632x337\) \(schmid-bach.com\)](#)
 Lower figure: [bim-clash-detection-and-resolutions-full.jpg \(724x609\) \(solid-er\)](#)



Geometry checks focus on the pure 3D representation of the BIM models. They control the shape, form, distance, and presence of given elements in the model. Typical geometry checks can include:

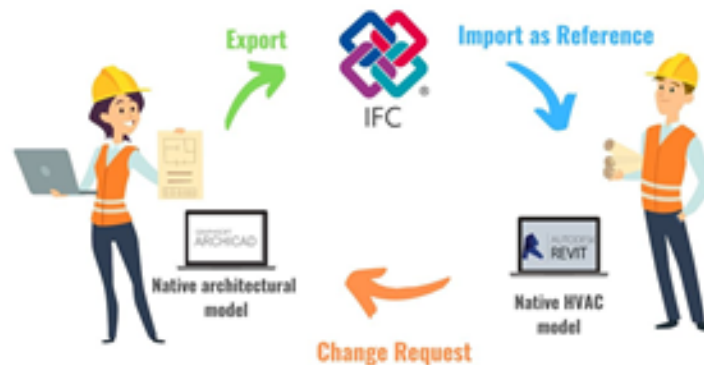
- Clashes (the clash detection itself) consists of a check on if 3D geometry of the different building elements intersect each other or near each other within a given margin, as demonstrated in Figures.
- Distances – validate if the distance between two elements is accurate and meets the design requirements
- Duplicates – a check on duplicates in the same place
- Presence/absence – of certain building elements: a basic check on what has been modelled or what elements are missing
- Clash detection of the whole design, when the specific models are merged together

Using IFC as format for Quality Checks

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Using IFC - Format for Quality Checks

- IFC – Industry Foundation Classes – is a standard format to share BIM models among disciplines
- Experts export discipline specific file formats to IFC, send it to BIM Manager for quality checks, then do changes back in the native format



<https://bimcorner.com/everything-you-need-knowing-about-the-ifc-format/>

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IFC is an Open BIM format, which can be read even by people with no access to specific BIM software. It is also a reason why it can be used for sharing and checks of the merged multidisciplinary BIM models.

In practice, a team starts creating a 3D model in one software, then exports IFC to another program, and continue working there.



We can imagine for example architects working in their native software to create an architectural model of a building. Then the model is exported to the IFC and passed it on to e.g. HVAC designers who use it as a reference to run the ducts. If there is a problem or a change is required (e.g. moving a wall or making a hole for the duct), they do not alter the IFC model themselves, but send a request to the architects with the specified changes. And that are the architects who perform the necessary modifications and exports the updated IFC model back to the HVAC team. The communication among the teams is led by BIM coordinator.

Quality checks of the merged model are (usually) done by BIM project manager.

He or she first downloads all discipline-specific models in .ifc format from project's Common Data Environment, or CDE, merges them in designated software, set up rules for checking, run the analyses and go through results in the end. Eventual issues will the manager address to a responsible designer for correction. The designer does the changes and exports updated .ifc files back to CDE. BIM project manager prepares reports describing the quality-checks results. As this is done in regular base, it is beneficial to automate ifc export and import.


Common Data Environment (CDE)

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Common Data Environment, CDE

- BIM project = huge amount of data
- Data is usually stored in a cloud-based application called CDE
- Data-sharing and communication among stakeholders
- Authorization of access to relevant parts of data



<https://constructible.trimble.com/productivity/what-is-a-common-data-environment-and-how-is-it-used-in-construction>

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BIM projects produce huge amounts of data. These should be stored and available to the participants via a centralized platform. This platform is called Common Data Environment, CDE, in the BIM context.

CDE ideally includes BIM data as well as project contracts, reports, material specifications and so on, from the whole building life-cycle. It thus facilitates data exchange, but it does not mean that everybody needs and should have access to all the documentation. Instead, people can be authorized to access only the parts relevant to them.

- CDE improves data accessibility. Ideally, CDE connects all project data that are updated in real-time. Each permitted user can access actual data whenever on whatever device.
- CDE prevent lost or incomplete data. Essential data are not lost or forgotten between project phases and among teams, as would probably happen if stored on individual computers or, even worse, in paper form. Thus, it reduces re-work and maximizes transparency.
- CDE improves project efficiency. Data are available for deeper analyses, leading to informed decision-making and improved project outcomes, such as on-time and under-budget delivery.
- CDE is defined and required by ISO 19650 standard.

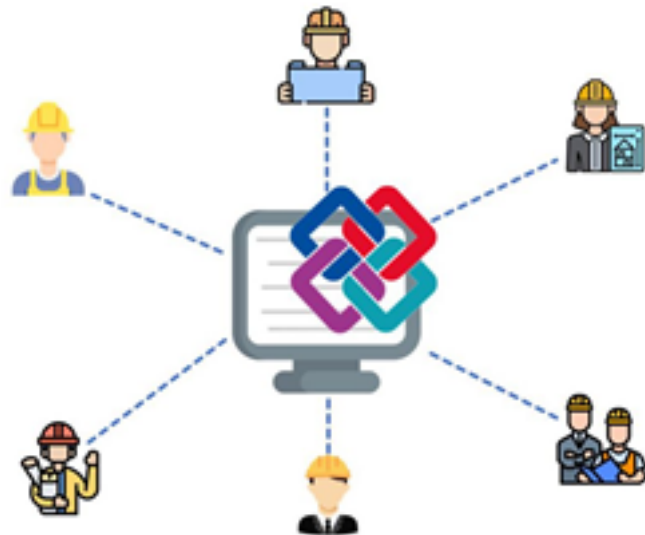
You can read also: <https://constructible.trimble.com/productivity/what-is-a-common-data-environment-and-how-is-it-used-in-construction>

CDE good-practices I

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CDE Good Practices I

- Access to right people to right data in right time
- Possible need of subcontractors' own CDEs
- Work automation using APIs



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Implementing CDE can take time, so that is good to be aware of the main points of good CDE practices. Some of them are summarized here:

1. Give the right people the right access at the right time

CDE allows project stakeholders to start collaborating sooner, but sharing project data too soon, or too late, can create confusion.

The ideal CDE solution is to divide users into groups with controlled access. One can have a group for owners, another for architects, and another for contractors. Then, one can determine which data each group needs to be able to view and when, and add or remove the groups during the LC.

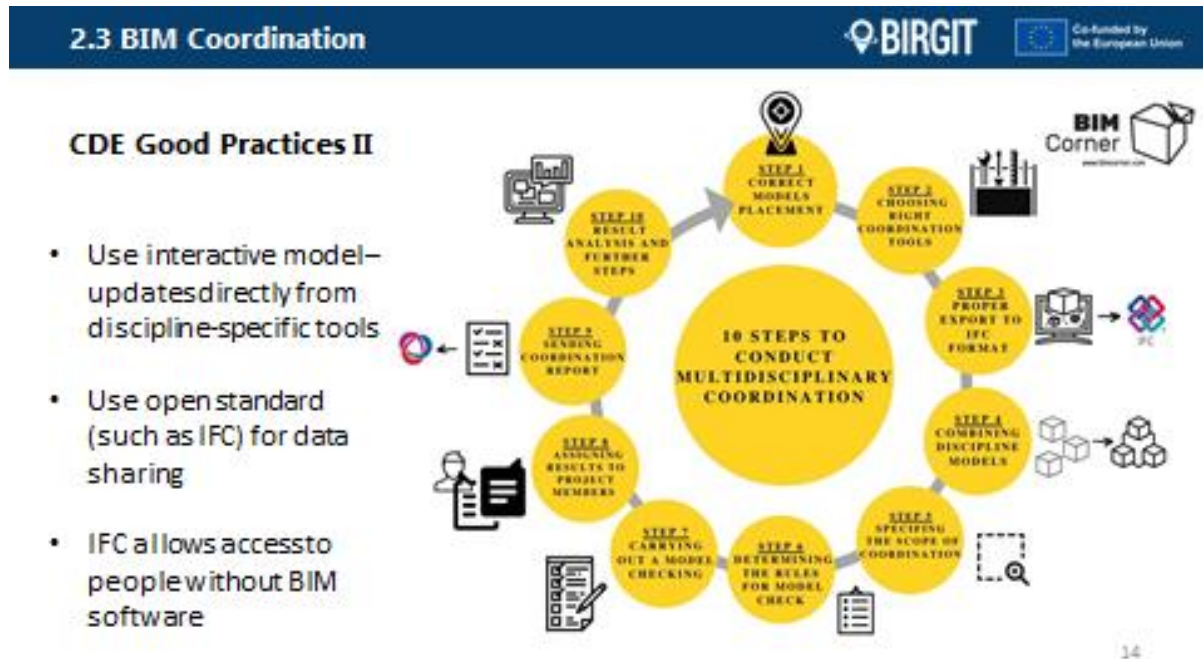
2. Support the need for individual CDEs

However, it is sometimes preferable to have several CDEs. Usually, it is case for subcontractors who have to perform intensive design, estimating, and cost analysis work. Running these in their own CDEs helps to centralize and protect their intern data, e.g. about costs and risk-assessments. They submit their models back to the general contractor in more finished form later on.

3. Automate workflows using APIs

To use object-oriented CDE with application programming interfaces (APIs) can seem complicated in the beginning, but can save much work when CDE is automatized. APIs helps e.g. with version control when each team works with own models. The APIss allow sharing information directly between the CDE and the models in internal design tools.

CDE good-practices II



4. Use interactive model

However, optimal is to use an interactive model where users can make updates directly from the tools they currently use, instead of uploading new files every time a change is made. Version control is no longer an issue. This enhanced model interactivity also supports Level 3 BIM maturity.

5. Leverage open sharing standards

Architects and engineers are typically the only project team members with access to BIM software. However, contractors and owners should also be able to revisit and extract detailed BIM data, which are not part of construction documents. Open standards (such as IFC) allow access BIM models without BIM software.

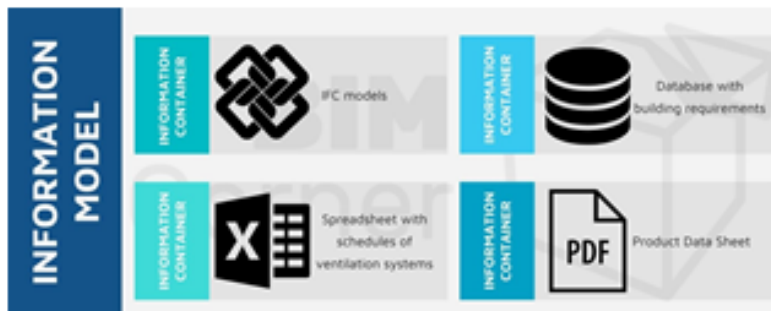
See also: [7 Best Practices for Using a Common Data Environment on Complex Construction Projects \(trimble.com\)](https://www.trimble.com/7-Best-Practices-for-Using-a-Common-Data-Environment-on-Complex-Construction-Projects), <https://bimcorner.com/cde-within-iso-19650-a-process-or-a-solution/>

BIM Information model according to ISO 19650

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BIM Model according to ISO 19650

- BIM model is set of "Information Containers" in ISO terms
- Information Container is any form of unique file
- Each file has unique ID
- Naming strategy is given by BEP
- PIM – Project Information model
- AIM – Asset Information Model



<https://bimcorner.com/iso-19650-terms-explained-in-a-simple-way/>

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Just to remind, the CDE cloud stores the BIM information model, i.e. the digital representation of the building project. Thus, CDE contains all the information related to the building's design, construction, and operation.

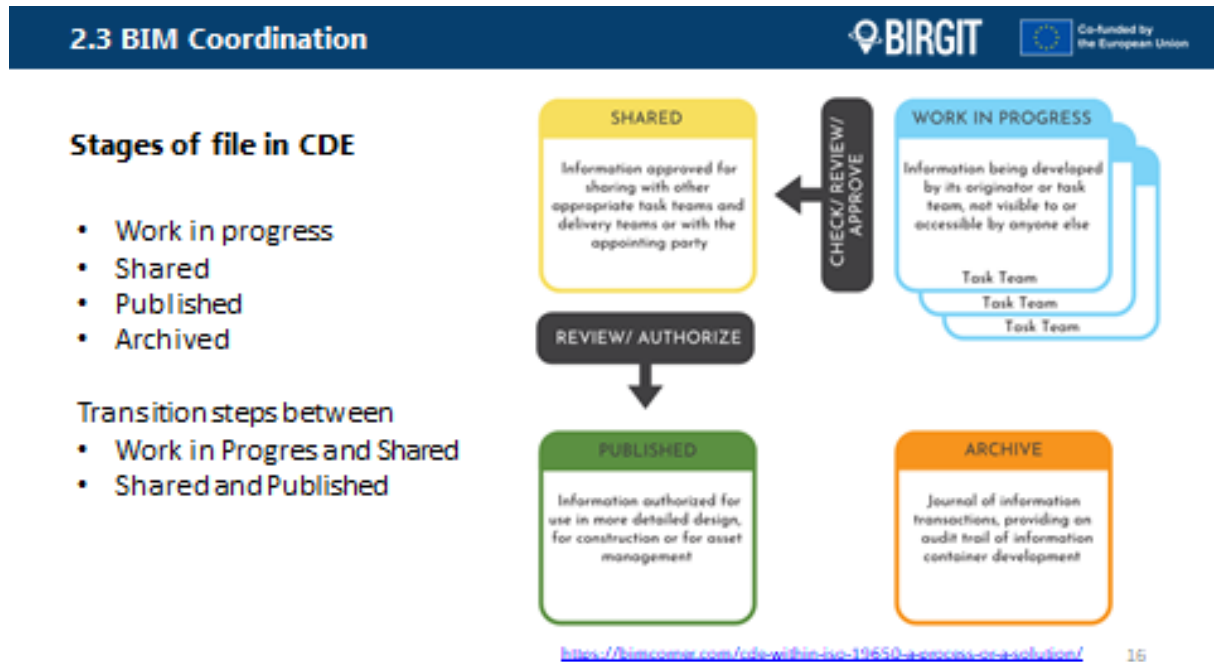
In ISO 19650 terms, BIM Information Model is a set of information containers. Information Container is any form of unique file. Consequently, this might be a file with structured information (containing metadata, e.g. geometrical models, schedules) or unstructured (information with no metadata, such as pdf documents, scans, photos, videos, e-mails).

Each information container (file) should be identified by unique ID. Ideally, the naming is consistent for the whole project and described in BEP. The name can include e.g. number of the building, discipline, classification code, type of file and file number.

Information model used during design and construction is referred as Project Information Model, PIM. It provides all the data required to carry out the delivery phase of an asset.

When the building is commissioned, relevant parts of PIM are transferred into the Asset Information Model, AIM. Data unnecessary for maintenance are archived elsewhere, so that the AIM comprises only information needed during the operational phase of the asset.

Stages of file in CDE



ISO 19650 distinguishes four stages during the file existence: Work in progress, Shared, Published and Archived, as visualised by the figure.

Work In Progress

First, when a team develops design or prepares a revision, the files should not be accessible to other working groups. A solution for WIP state might be limited access in CDE or an internal CDE (as we discussed earlier).

Check / Review / Approve transition

When the files are ready, the model is checked if it is in compliance with project requirements and standards. This is done by an appointed specialist who verifies and accepts the model.

Shared state

The accepted model is shared with other teams in the CDE in the IFC format.

However, the files are not editable yet, but they may be consulted by all other teams in order to coordinate development of the merged model.

If some changes are necessary, the files are moved back to the “work in progress” state for modification by their author team.

Review / Authorize transition

The modified files are checked again and if they meet project requirements, they are moved on to the “Published” state. If there are still some flaws, the files go back for one more revision to the “Work in Progress”.

Published state and Archive

At this level, there are just files authorized to use by other teams for further construction or for the maintenance.

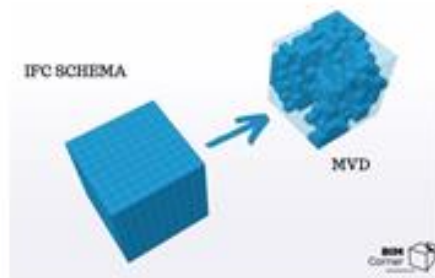
Files, that are no more needed, should be then archived as a track of the development and for possible control in future.

<https://bimcorner.com/cde-within-iso-19650-a-process-or-a-solution/>

Model View Definition, MVD

2.3 BIM Coordination

Model View Definition, MVD



- Smart filters to export relevant subset of BIM data only
- Predefined in BIM software or user-defined
- e.g. MVD for Quantity Surveying, Facility Management Handover MVD

Figures: <https://bimcorner.com/22-items-in-bim-you-should-know-update/> (left), IFC Export rules, Part 3: Why is it important? - BIM Corner (right) 17

Just to remind us again, millions of data points are created in any BIM project, by different disciplines. However, one does not usually need all the data, but only data needed at the specific stage of the process. It is therefore better to export only a relevant subset of the BIM model; that is to say a subset of the general IFC file.

This subset of the general IFC file is called Model View Definition, MVD. The MVD makes it easy to extract only those necessary IFC data, which meet specific criteria.

MVD needs to change during the life-cycle. There is e.g. MVD for Quantity Surveying and price calculation of the project, a Facility Management Handover View or the most commonly used Coordination View. This Coordination View is used by BIM coordinator to merge models for visualisation and quality checks. It has optional add-ons, for example **2D Annotation View** generating 2D floorplans.

Implementing BIM in a company

2.3 BIM Coordination

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Implementing BIM in a Company

- Diverse aspects to meet to start with BIM
- Expertise, employee training and IT solutions

The Holy Grail of Successful **BIM Adoption**

People

Raising awareness about BIM in your company/team will lead to increased confidence and interest, inclining your team members towards BIM adoption.

Process

When you migrate to new technology, it involves a massive change in the workflow. Your design team must be aware of the implication of alteration in the workflow process.

Technology

Make your clients aware of the benefits of BIM in the long run. You can sync a client's objectives with BIM use cases to showcase how BIM adoption will promise a competitive edge for their project.

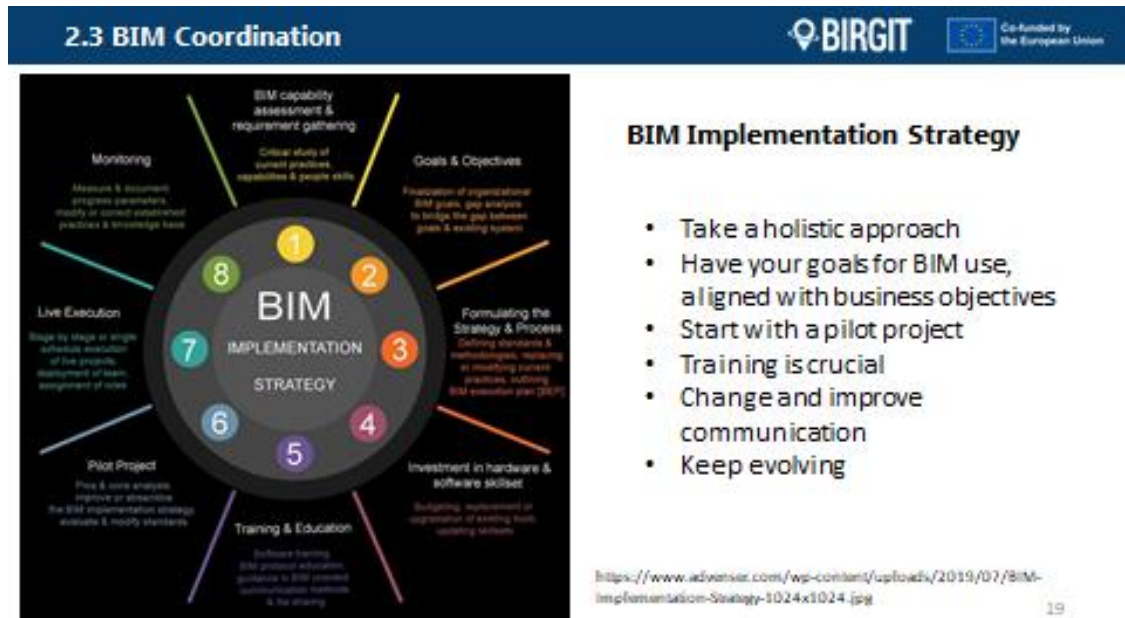
846.117.7305
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To start with BIM requires a considerable build-up of expertise, employee training and IT upgrading.

That is because every BIM project needs to manage numerous different aspects. These aspects are:

- Technological – to select technologies, to prepare a common data environment, to resolve interoperability
- Legal – to harmonize the contracts and BIM protocols, to ensure use of standards and solve data-ownership
- Communication for successful cooperation
- Personnel and competencies, to ensure that all participants have sufficient knowledge or get training
- Environmental – to ensure that the project meets environmental targets and policies
- Quality control and management – to continuously monitor all the aspects named above

BIM Implementation Strategy



To get the BIM project to proceed smoothly, all participants have to acquire understanding for the BIM benefits and will to use the technology despite the challenges.

That is why big companies were the first to adopt the BIM approach.

Small companies might have problems to ensure all the competencies needed and to afford the initial investments. However, use of BIM pays off in the long term and is more and more required in new project tenders (see BIM Maturity below). Even in small projects brings BIM clear advantages, being a market niche for the small companies.

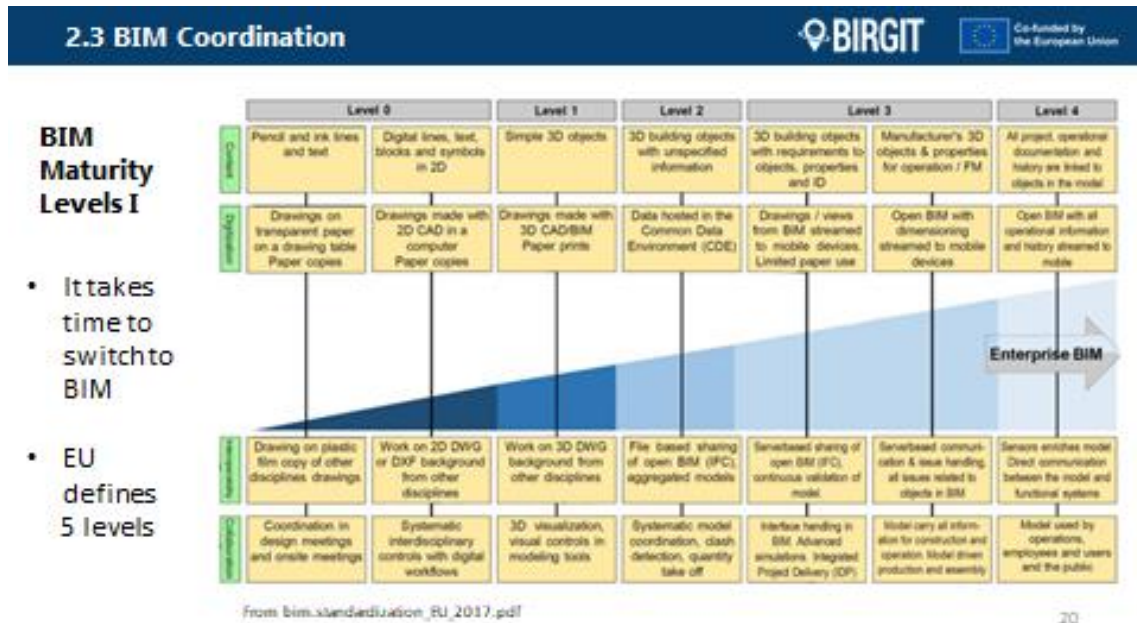
Read more at:

[How to start with BIM in 12 steps? Part 1 – Bim Corner BIM for beginners](#)

[HOW TO START WITH BIM IN 12 STEPS? PART 2 – Bim Corner](#)

[BIM Implementation: complete guide to BIM strategy - BibLus \(accasoftware.com\)](#)

BIM maturity levels I

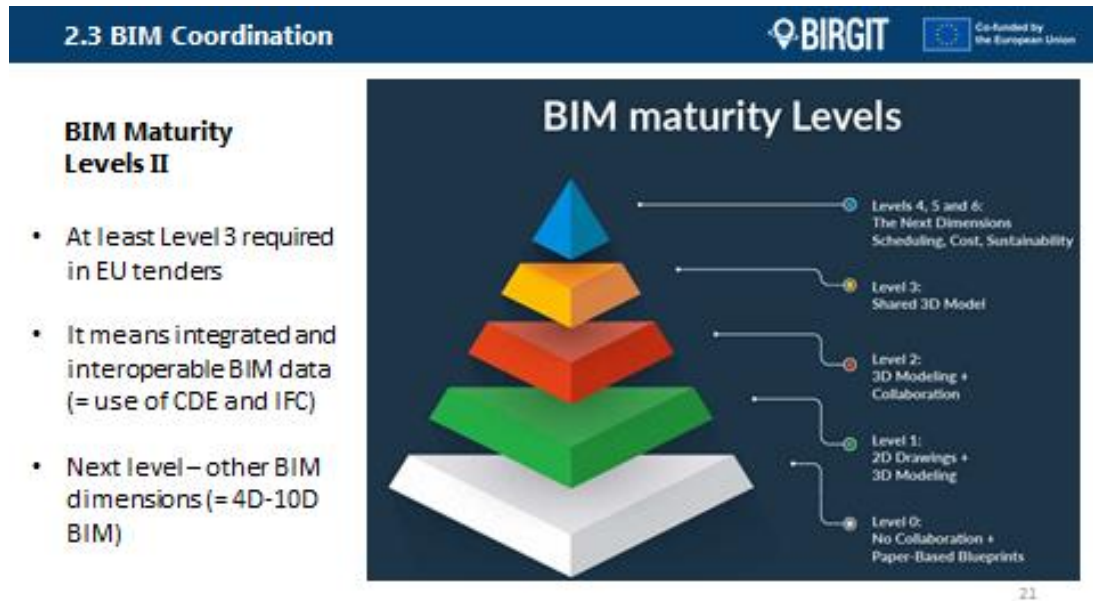


It is not possible to suddenly move from the traditional approach towards BIM. The change is going progressively, step by step.

In order to assess the maturity of BIM adoption on a project or within an organization, there is the concept of "BIM Maturity Levels". The individual levels define what criteria are required to reach to move into the next level or, ideally, to the fully digitalised building process.

EU recognises five BIM maturity levels. Each level has indicators to see if it has been reached. They measure four aspects: content, digitalization, interoperability and collaboration.

BIM maturity levels II



The BIM maturity indicators are summarized in the Figures. Most of the new projects in Europe require BIM on Level 3, at least. It means that objects should be defined in 3D including their properties, should be accessible in digital form via user-friendly interfaces and shared even in open format (IFC).

It means that companies unable to guarantee the Level 3 will not be taken into account in the tenders.

The following level, the forth one, includes to use 4D-10D BIM, i.e. the next BIM dimensions as we spoke about in Lecture 1.3. LODs and 3D to 10D BIM.