BIM-enabled Learning Environment (BLE)
Course Manual:
Pilot Module 1 – Design Management

By: Tampere University, Finland

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PROJECT DELIVERABLE DETAILS

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1 General Introduction to Course Manuals

1.1 Background and purpose

Digitalization is transforming the real estate and construction (REC) sector and a key feature of this transformation is Building Information Modelling (BIM). BIM refers to the digital representation of buildings and construction operations and it offers opportunities for improving education and training through data rich virtual environments in which project-based learning experiences can be designed and delivered. This could fundamentally change the education and training of REC sector professionals from managers to site workers.

The BIM-enabled Learning Environment for Digital Construction (Benedict) project is an Erasmus+ Strategic Partnership between Tallinn University of Technology (TalTech), Tampere University (TAU) and the University of Bologna (UNIBO) aimed at leveraging the possibilities of BIM to enhance education and training by developing an innovative, BIM-enabled Learning Environment (BLE). The BLE platform is an integrated Moodle – DiStellar installation that is publicly available at www.bim-enabled-learning.com .

To demonstrate the application of the BLE in learning, the project team has developed a series of three pilot course modules that apply BIM-enabled learning using the BLE. These are:
1) Design Management - lead by TAU;
2) Risk Management - lead by TalTech;
3) Time Management - lead by UNIBO.

As the BLE is a novel and innovative concept, it is important to provide clear and easy-to-use guidance materials for all potential users. The purpose of this course manual (which is part of a set of 3 manuals – 1 manual for each module) is to ensure that interested stakeholders (programme directors, teachers, trainers, students, trainees) have access to the full details of the pilot modules so that they can:

- make use of the modules directly, or,
- adapt them to suit their own purposes, or,
- use them as templates for creating their own modules, or,
- simply gain ideas and inspiration for their own, related projects.

1.2 Objectives and scope of the pilot modules

The pilot modules were designed to demonstrate how teachers and students of construction-related disciplines can leverage Building Information Modelling (BIM) in their learning activities for:

• Visualizing the project
• Simulating building scenarios
• Analyzing and designing buildings and building elements
• Identifying conflicts between systems
• Developing estimates, e.g. for materials quantities (bill of quantities BOQ), activity durations (time schedules), costs (budget)
• Design and build decisions
• Project and construction management applications.

All partners were actively involved in the design, development and validation of the learning activities. A comprehensive evaluation tool to assess the modules was developed and applied by the Centre for Engineering Pedagogy at TalTech. (The resulting evaluation and assessment toolbox for BIM-enabled learning has been separately reported). The pilot modules were demonstrated to stakeholders at the Benedict project's 2nd Multiplier Event that was held in Tallinn in June 2022 and were directly used to teach students during the 2022/23 academic year in all 3 partner universities.

1.3 Structure of the Course Manual

All course manuals follow the same basic structure: in section 2 a brief introduction to the subject of the particular pilot module and why it was chosen is given. Section 3 describes the intended learning outcomes and section 4 presents the structure and delivery process for the module. Teaching methods and assessment procedures are described in sections 5 and 6 respectively, and, an overview of the teaching materials is provided in section 7. All the actual slides, assessment forms, assignment templates, etc. are attached to the manual as appendices.

2 Introduction to the Design Management Module

Design Management was chosen as a topic as collaboration and coordination are at the centre in design management. These functions and competences are becoming more and more important in the Real Estate and Construction industry. BIM is argued to enable improved collaboration and coordination not only due to its highly visual nature, but more due to the technical abilities for sharing information and for 3D coordination. Therefore, this topic suited well to test BIM-enabled learning. Concept design stage was chosen as a more specific stage to be focused on. This enabled the focus on analysis, simulation and integration execution and the length was also suitable for the initial pilot module implementation, to test the concept.
The course activities are undertaken in the form of role play and simulation of the concept design process.

3 Learning Outcomes

On completion of the design management module, it is expected that the student:

- understands the concept design stage processes, the connection between different roles, design disciplines and design options;
- understands their own role and is able to function in their role independently and to collaborate and communicate with other stakeholders; and
- knows the common BIM requirements and is able to apply them into their role specific tasks.

4 Module Structure

4.1 Scope of the module

The module focuses on the concept design of a project, and on the analysis, simulation and integration execution, not on the actual design tasks in the project.
Topics include, but are not limited to

- Spatial programme evaluation
- Design review
- Design schedule development
- Cost estimation
- Model validation
- Documentation of meeting minutes and agendas

4.2 Module delivery process

Students work individually and collaboratively on a simulated project to complete concept design stage activities. As design management happens between multiple parties in a project, students adopt the roles of these parties to work together as a design management team. Faculty's role is to facilitate the process and to provide feedback and advice as needed.
The module consists of:

1. An introductory lecture on Building Information Management
2. Four design management meetings (figure 4.1):
   I. Opening meeting for project introduction and role selection
   II. 1st design meeting to discuss the design
   III. 2nd design meeting to discuss the further developed design
   IV. Stage gate meeting to conclude the concept design stage

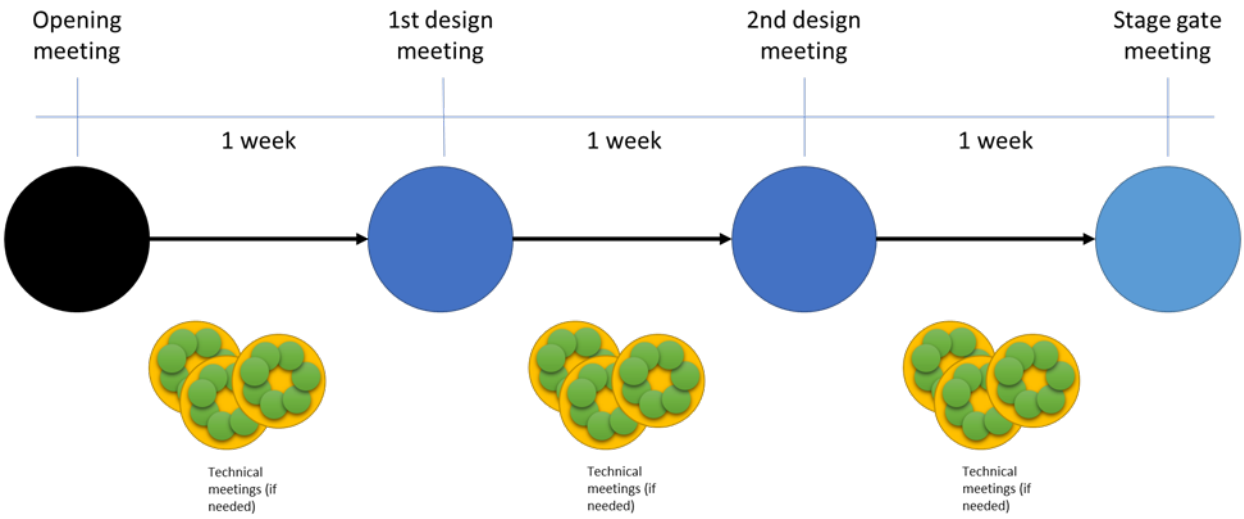


Figure 4.1 Timeline for the Design Management module delivery

5 Teaching Methods

This is a project-based module relying on social constructivism and students as independent (from teachers) learners.

Students are organised into stakeholder groups (Client, Architect, BIM coordinator, etc.) and, to an extent, students' specialisations (architecture, construction management, structural engineering, etc.). Depending on the students' specialisations and number of students on the module, stakeholder groups' sizes vary from one student to multiple. Students work in their roles sequentially and in collaboration to analyse, simulate and integrate the building design using BIM model(s) and other available resources. Students work independently, both individually and as a project team. Faculty members' and industry mentors' role is to facilitate the process at agreed milestones, which include the design review meetings as a

minimum. Students run the meetings. Facilitators' role in the meetings is to provide feedback and advice as needed.

Introductory lectures are offered to introduce the module, the project, and depending on the students' previous knowledge to introduce BIM as a concept. Supporting resources on specific topics are offered as needed during the module.

6 Assessment Procedures

Formative assessment is provided at the end of each meeting in the form of facilitator feedback. Summative assessment is based on students' active participation in the meetings and in performing the required role-specific tasks. A pass/fail grading system is recommended for this module as it is based on active collaboration and the focus should be on ensuring that all students are engaged and actively work through their role-specific activities. It is also possible to arrange a quiz at the end of the module to test how well the students have achieved the learning outcomes. For the initial pilot module implementation at Tampere University, as it formed part of a larger course, a few module-related questions were included in the overall course exam. The exam questions were formulated as follows:

Name your role in the Design management simulation project
Name two other roles in the project and explain

- *How you (in your role) collaborated and communicated with these roles in the project?*
- *How your collaboration assisted in the achievement of the project goals?*

7 Teaching Materials and Sessions

7.1 Introductory Lecture

The introductory lecture is an introduction to Building Information Management (BIM). The detailed content of this depends on students' previous knowledge on BIM. The material provided in Appendix A.1. is suitable when the students have very little or no knowledge on BIM.

The BIM intro quiz can be used at the end of the introductory lecture either as an individual, pair or group activity. The quiz material is provided in Appendix B.1.

7.2 Opening meeting

The opening meeting sets the scene for the entire module. It gives students an overview of the module, the project and prepares them for the design management meetings. This requires students to familiarise themselves with the module, the project and the roles. In the opening meeting, students/student groups choose their roles through a negotiaton process with other students. Information about the roles may be provided before the meeting, especially if the students are at the beginning of their studies and do not have a full understanding of all the

roles. More information about the roles and the role-specific tasks can be found in the BLE itself. Powerpoint slides for the module and the project introduction are provided in Appendix A.2 and A.3.

7.3 Design management meeting 1

Between the Opening meeting and the Design management meeting 1 students familiarise themselves better with the project, their role-specific tasks and materials. The architect in the project is given (as this module does not include full design tasks) the first development of the concept design to be introduced in the meeting. This is in the form of a Building Information Model. Other role-specific materials include e.g. spatial programme (spreadsheet) and materials that students have found themselves by investigating the project.

Design management meeting 1 begins with the architect to present the concept design. Preliminary project schedule and cost estimation are introduced by the scheduler and cost estimator. These are all discussed and evaluated in the meeting. Students in other roles, such as structural, geotechnical or MEP engineers, are to engage with the design and provide their advice and comments on the design. The project manager is to run the meeting and record the minutes of the meeting. At the end, the client confirms how they want to proceed with the design. Communication and project management tools are to be decided in this meeting, if not decided already in the Opening meeting. Material is prepared by the students.

7.4 Design management meeting 2

The concept design is further developed between the meetings. This includes the development of the design itself, the project schedule, cost estimation, a draft BIM Execution Plan and any other plans by the project parties. Students should communicate and run their own meetings between the design management meetings as needed. The next version of the development is then introduced by each party to the client and the rest of the design team in the Design management meeting 2. As the BIM model was introduced in the previous meeting, this should now be used for data extraction for cost estimation purposes. An application for this is provided in the BLE itself. Material is prepared by the students.

7.5 Stage gate meeting

Stage gate meeting refers to the end of the concept design stage and as the name implies, focuses on closing the project stage in order to move to the next stage. As previously, students should communicate and run their own meetings between the design management meetings as needed. The final concept design is introduced to the client in the Stage gate meeting by all parties including the design itself, the developed project schedule, cost estimation, BIM Execution Plan and any other plans as applicable. The client makes a decision on how to proceed to the next stage. Material is prepared by the students.

7.6 Assessment

Formative assessment takes place as feedback and discussion after each design management meeting.

Summative assessment includes evaluation of student participation and engagement, and exam questions. This is discussed in chapter 6.

Students are required to reflect on their own learning experiences during the module. An example questionnaire format for the self-reflection exercise is provided in Appendix C.1.

Appendix A – Presentation Slides

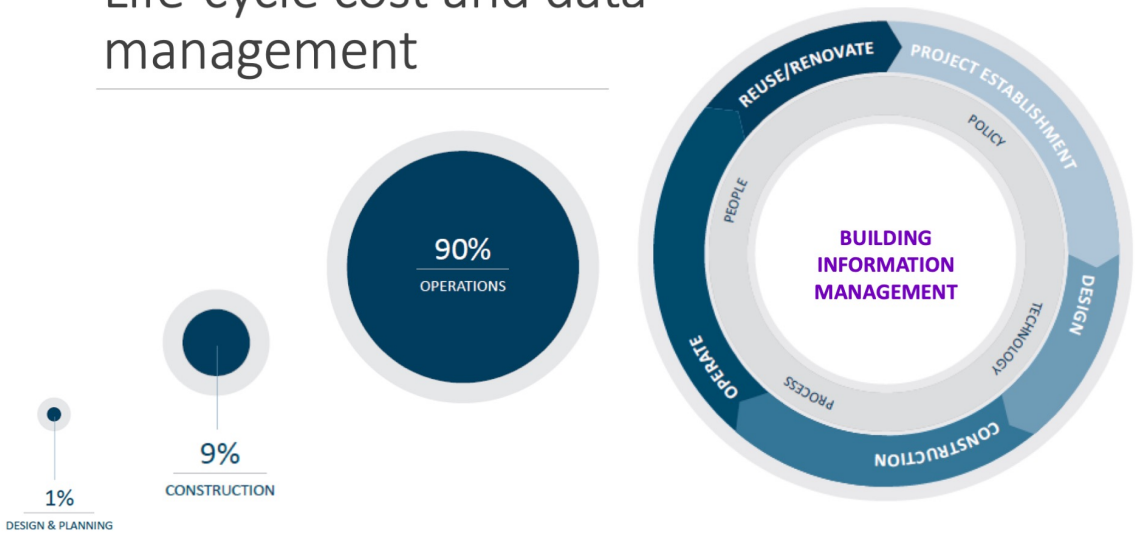
A.1. BIM introduction

(From next page)

BIM

MATERIALS BY: TAIJA PUOLITAIVAL, TONI TEITTINEN AND KATH DAVIES

Life-cycle cost and data management



- NZ BIM Handbook

BIM defined

"Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.

A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder."

NBIMS-US - https://www.nationalbimstandard.org/faqs

Building information modelling…

So what's a model?

So what's a model?

So what's a model?

So what's a model?

So what's a model?

So what's a model?

So what's a model?

So what's a model?

model

NOUN

1. A three-dimensional representation of a person or thing or of a proposed structure, typically on a smaller scale than the original.

   'a model of St Paul's Cathedral'

2. A thing used as an example to follow or imitate.

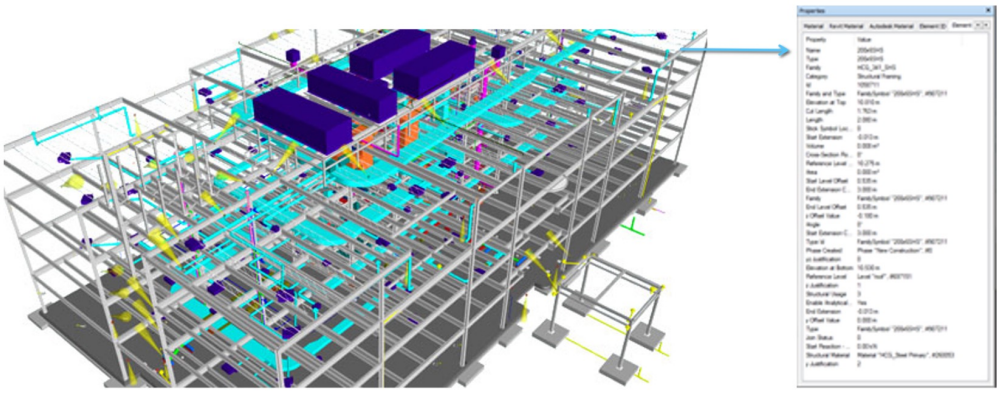
   'the project became a model for other schemes'

3. A simplified description, especially a mathematical one, of a system or process, to assist calculations and predictions.

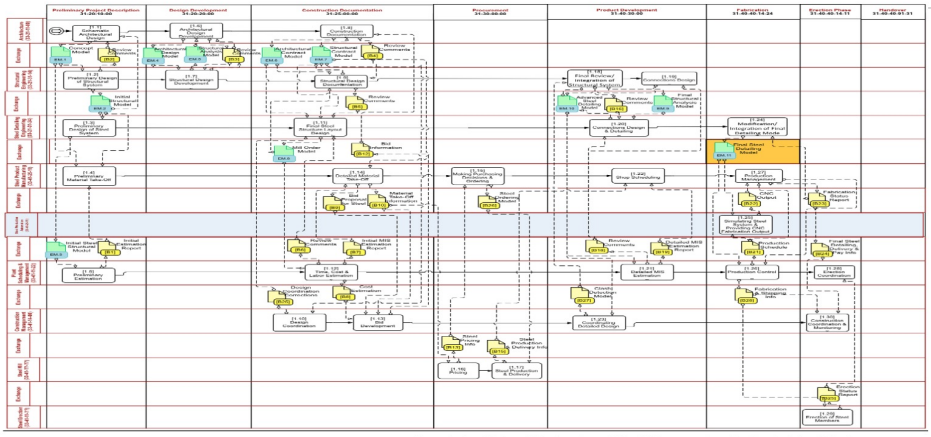
   'a statistical model used for predicting the survival rates of endangered species'

Oxford Living Dictionaries, https://en.oxforddictionaries.com/definition/model

What's a Building Information Model?

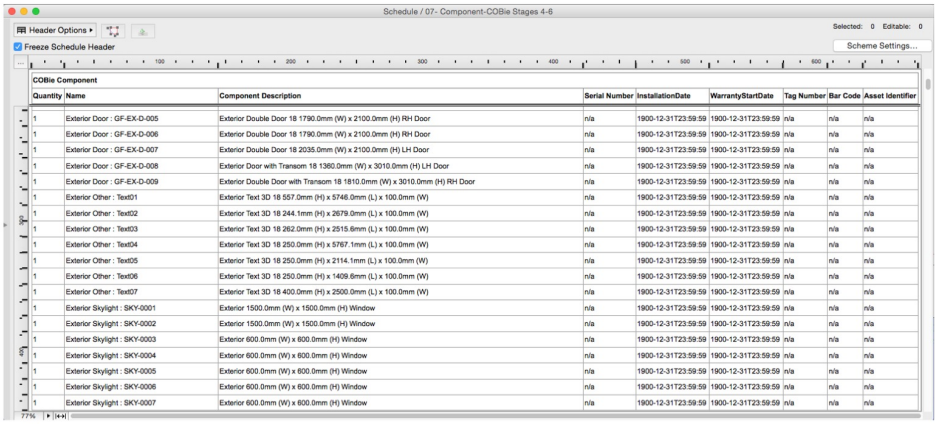


But it can look like this...



Georgia Institute of Technology http://dcom.arch.gatech.edu/aisc/idm/process_map

or like this...



Schedule / 07- Component-COBie Stages 4-6

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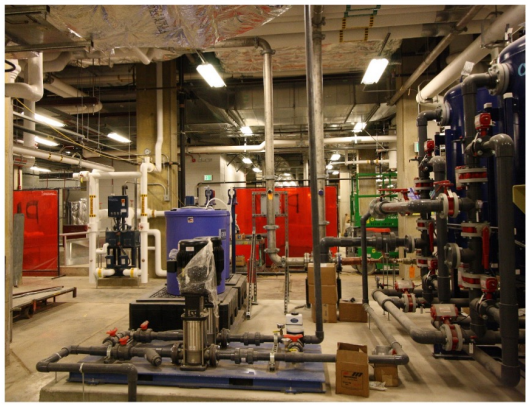
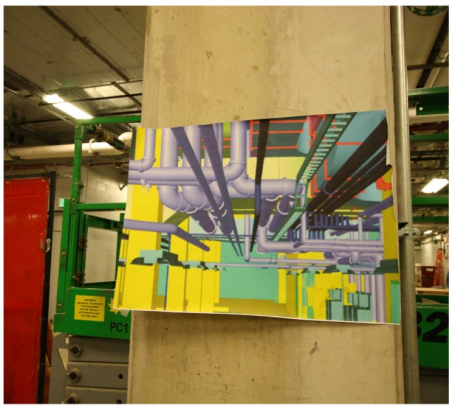
COBie Component

Quantity	Name	Component Description	Serial Number	InstallationDate	WarrantyStartDate	Tag Number	Bar Code	Asset Identifier
1	Exterior Door : GF-EX-D-005	Exterior Double Door 18 1790.0mm (W) x 2100.0mm (H) RH Door	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Door : GF-EX-D-006	Exterior Double Door 18 1790.0mm (W) x 2100.0mm (H) RH Door	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Door : GF-EX-D-007	Exterior Double Door 18 2035.0mm (W) x 2100.0mm (H) LH Door	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Door : GF-EX-D-008	Exterior Door with Transom 18 1360.0mm (W) x 3010.0mm (H) LH Door	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Door : GF-EX-D-009	Exterior Double Door with Transom 18 1810.0mm (W) x 3010.0mm (H) RH Door	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Other : Text01	Exterior Text 3D 18 557.0mm (H) x 5746.0mm (L) x 100.0mm (W)	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Other : Text02	Exterior Text 3D 18 244.1mm (H) x 2679.0mm (L) x 100.0mm (W)	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Other : Text03	Exterior Text 3D 18 262.0mm (H) x 2515.6mm (L) x 100.0mm (W)	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Other : Text04	Exterior Text 3D 18 250.0mm (H) x 5767.1mm (L) x 100.0mm (W)	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Other : Text05	Exterior Text 3D 18 250.0mm (H) x 2114.1mm (L) x 100.0mm (W)	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Other : Text06	Exterior Text 3D 18 250.0mm (H) x 1409.8mm (L) x 100.0mm (W)	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Other : Text07	Exterior Text 3D 18 400.0mm (H) x 2500.0mm (L) x 100.0mm (W)	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Skylight : SKY-0001	Exterior 1500.0mm (W) x 1500.0mm (H) Window	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Skylight : SKY-0002	Exterior 1500.0mm (W) x 1500.0mm (H) Window	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Skylight : SKY-0003	Exterior 600.0mm (W) x 600.0mm (H) Window	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Skylight : SKY-0004	Exterior 600.0mm (W) x 600.0mm (H) Window	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Skylight : SKY-0005	Exterior 600.0mm (W) x 600.0mm (H) Window	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Skylight : SKY-0006	Exterior 600.0mm (W) x 600.0mm (H) Window	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a
1	Exterior Skylight : SKY-0007	Exterior 600.0mm (W) x 600.0mm (H) Window	n/a	1900-12-31T23:59:59	1900-12-31T23:59:59	n/a	n/a	n/a

Rob Jackson, Bond Bryan Digital. http://bimblog.bondbryan.com

What does BIM look like in practice?

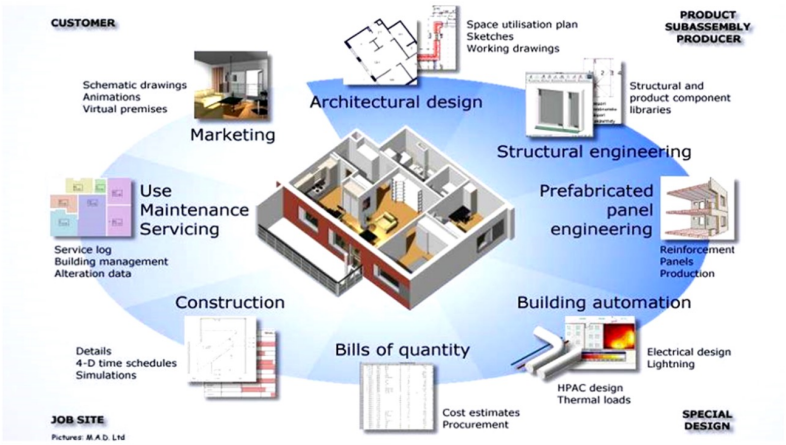




Modelling information

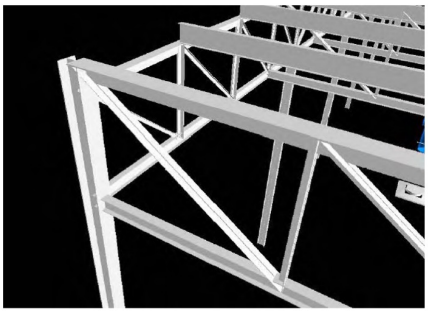
Information model	Output	Interpretation	
		Human	Computer
Picture information model (scanned)		Door	Pixels
Drawing information model		Door	Lines / arcs
Geometry information model		Door	Surfaces / volumes
Building information model		Door	

Different stakeholders require different information and approaches

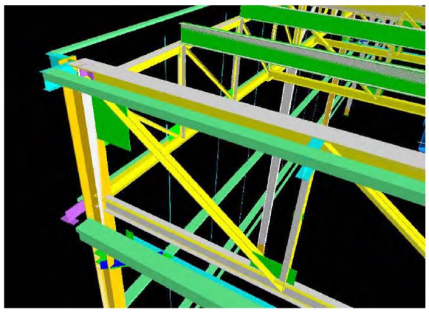


Stakeholders' needs change at different project stages

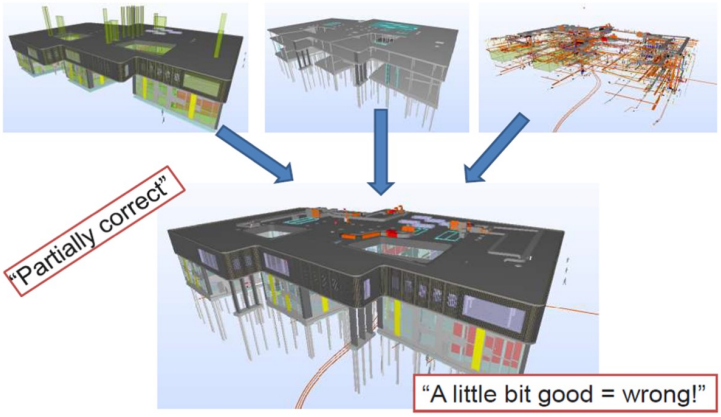
Preliminary design



Steel fabricator model



Stakeholders need to understand each others' needs

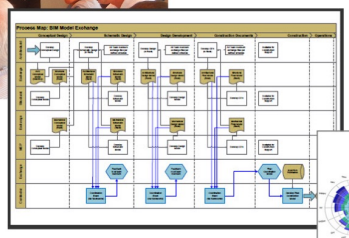


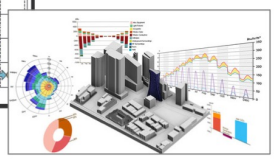
Hendriks, 2015

Four parts to the BIM equation

People

Process &
Policies





Technology

People come first…

Collaboration starts from the top

Work with "BIM Champions"

Train across the team

Work with strengths (not with weaknesses)

Communicate within and between teams

Make it about collaboration, not confrontation

Process & Policies follow…

Project BIM Strategy – start with the end in mind

Project BIM Execution Plan – get everyone on the same page

Process maps/workflows

Standards and protocols

Technology is the implementer…

Which hardware is needed?

Which software is best for the job?

Cloud or local servers?

What are the client's requirements?

What are the team's requirements/limitations?

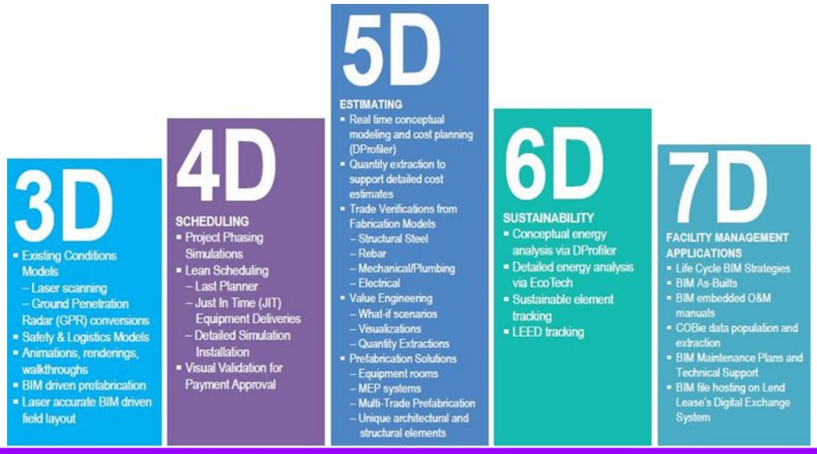
Project needs (should) drive BIM uses

How does the project benefit?

How does the organisation benefit?

What does the client want? (and what are they going to do with the BIM?)

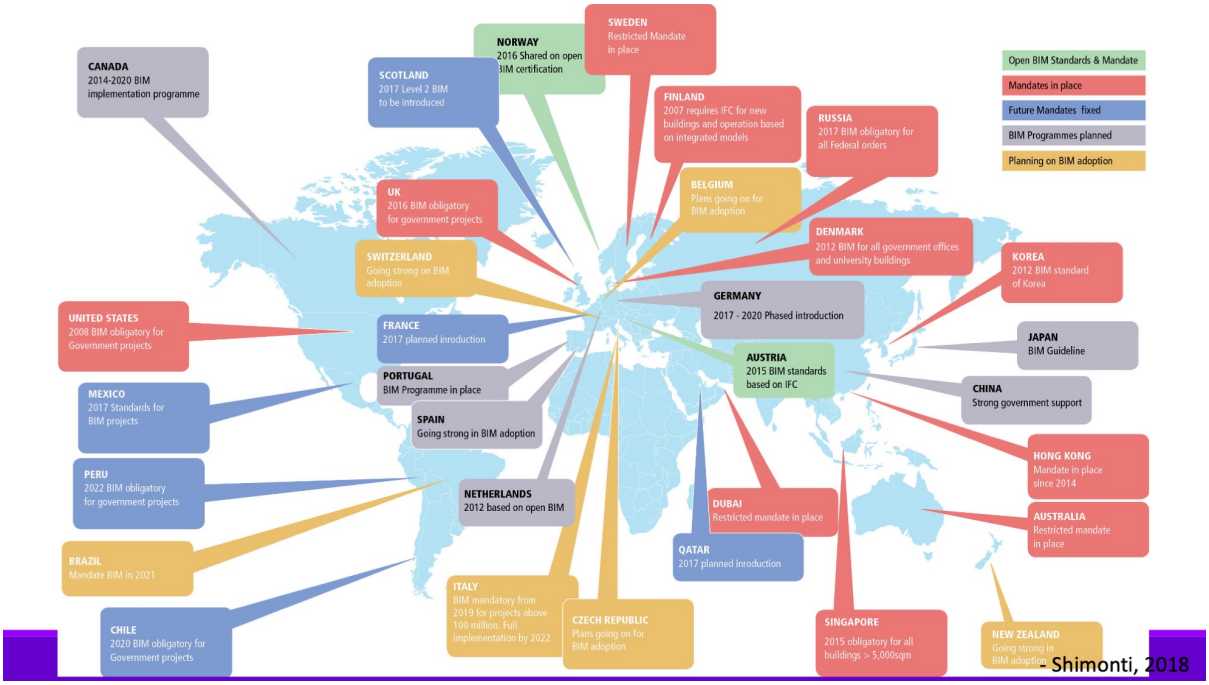
Information determines uses – Uses determine information



bimporn.tumblr.com

BIM uses (adopted from the NZ BIM Handbook (2019)

Existing Conditions Modelling	Cost Estimation	Phase Planning	Spatial Programming	Site Analysis
Design Review	Design Authoring	Engineering Analysis	Sustainability Evaluation	Code Validation
3D Coordination	Site Utilisation Planning	Construction System Design	Digital Fabrication	3D Control and Planning
Record Modelling	Asset Management	Building Maintenance Scheduling	Building System Analysis	Space Management and Tracking
Disaster Planning				



– Shimonti, 2018

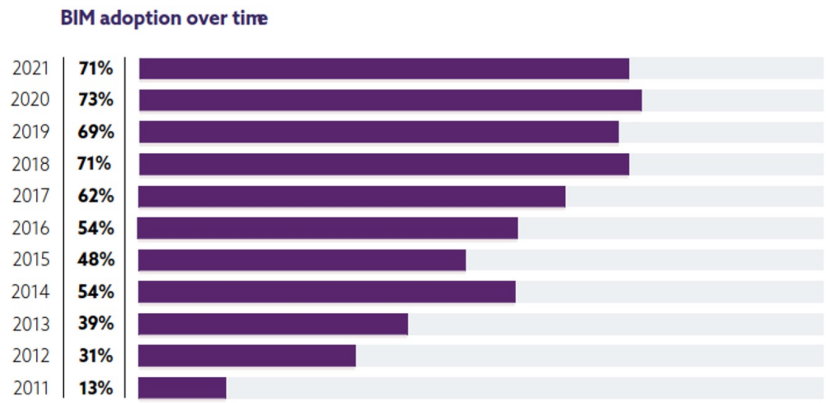
Activity

How is BIM implemented in your home country?

- Are there national standards?

- Examples of companies using BIM

BIM adoption in the UK



- NBS, 2022

Benefits

- Increased coordination between parties
- Improved efficiency, and
- Better accuracy and understanding within complex design

"We are better practitioners and our staffing skill has improved. We are also receiving an increased market share/recognition because of our ability."

"Higher quality of design due to better coordination, better ownership of the buildability of our designs."

"Consistency of documentation, useful communication tool internally and externally, automation of some processes, scenario testing/optimisation."

- eboss, 2018

Barriers

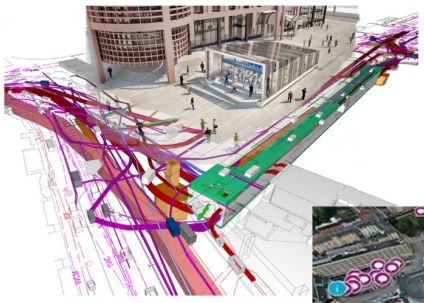
- Lack of coordination or quality interaction between parties
- Perception of cost
- Lack of skills and knowledge
- Switching between 3D models and 2D documents

"No common approach used. The models are really updated by the consultants, the 2D documents are followed and the consultants manually edit them to save time. No one point of truth federated model is used."

"Skill shortage within the industry at both the design and construction interfaces, this is focused on the creation and use of the model. Another issue could be considered 'weaponised BIM' where models that have not been an agreed deliverable to contractor are 'clash detected' without consideration for what is best for project and coming up with 1000s of clashes, when in reality it is due to the way in which the model has been created i.e. no penetrations modelled for MEP going through walls as this was not an agreed deliverable. Pure understanding of what BIM is and that it means different things for different projects, it isn't a one size fits all approach."

- eboss, 2018

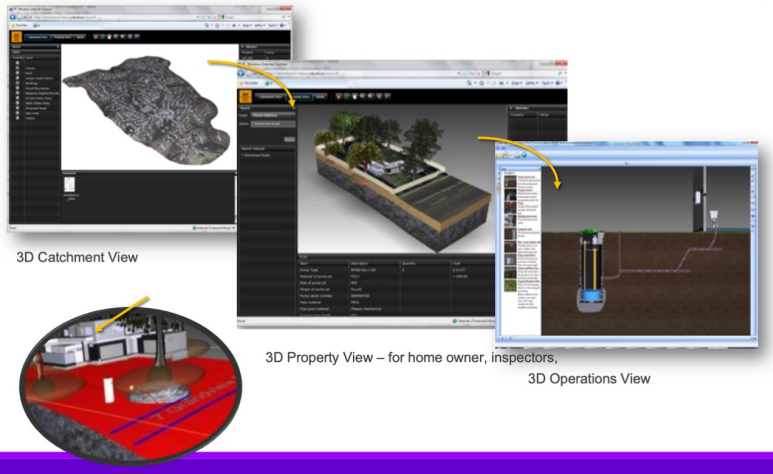
Urban Information Modelling



Integrating BIM with GIS

Urban Information Modelling

Multi-scale data



Other digital technologies in the built environment

Extended reality

Drones and advanced imaging

Sensors and IoT

Big data

Artificial Intelligence

3D printing and robotics

Etc.

Sources

AECOM

BIM101

BIM Acceleration Committee

bimporn.tumblr.com

CRC for Construction

Eboss

Gartner

Georgia Institute of Technology http://dcom.arch.gatech.edu/aisc/idm/process_map

Hendricks (2015)

M.A.D Ltd

NBIMS-US - https://www.nationalbimstandard.org/faqs

NBS

Oxford Living Dictionaries, https://en.oxforddictionaries.com/definition/model

Rob Jackson, Bond Bryan Digital. http://bimblog.bondbryan.com

Shimonti

A.2. Introduction to the module

(From next page)

BIM-enabled Design Management at concept design stage

Introduction to the module

Learning outcomes of the module

After completing the module, the student

- understands the concept design stage processes, the connection between different roles, design disciplines and design options
- Understands their own role and is able to function in their role independently and to collaborate and communicate with other stakeholders
- knows the common BIM requirements and is able to apply them into their role specific tasks

Content

The module will focus on the concept design of a project, and on the analysis, simulation and integration execution, not on the actual design tasks in the project

Topics include, but are not limited to

- Spatial programme evaluation
- Design review
- Design schedule development
- Cost estimation
- Model validation
- Documentation of meeting minutes and agendas

Delivery - method

Students work individually and collaboratively on a simulated project as needed to complete concept design stage activities

Faculty's role is to facilitate the process and to provide feedback and advice as needed

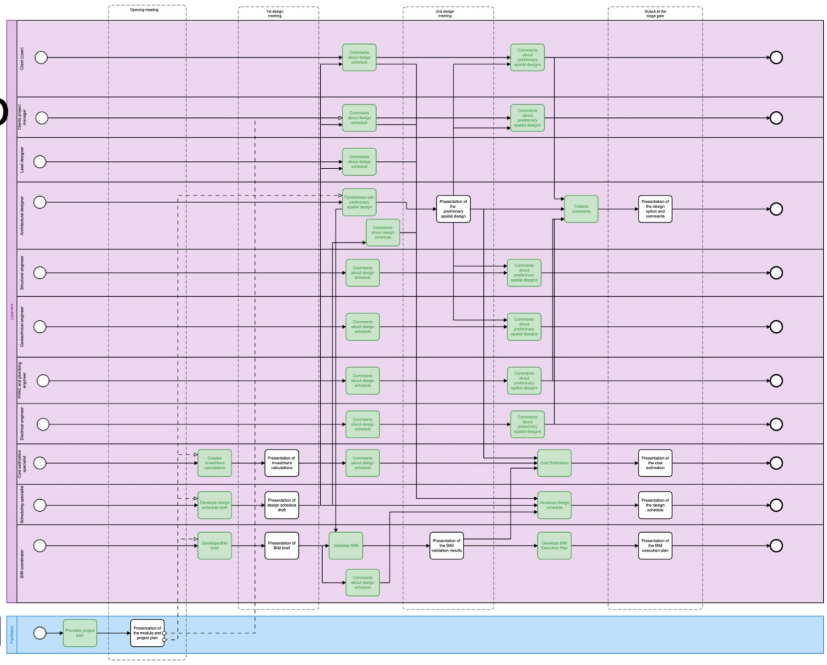
Delivery mode options for the module

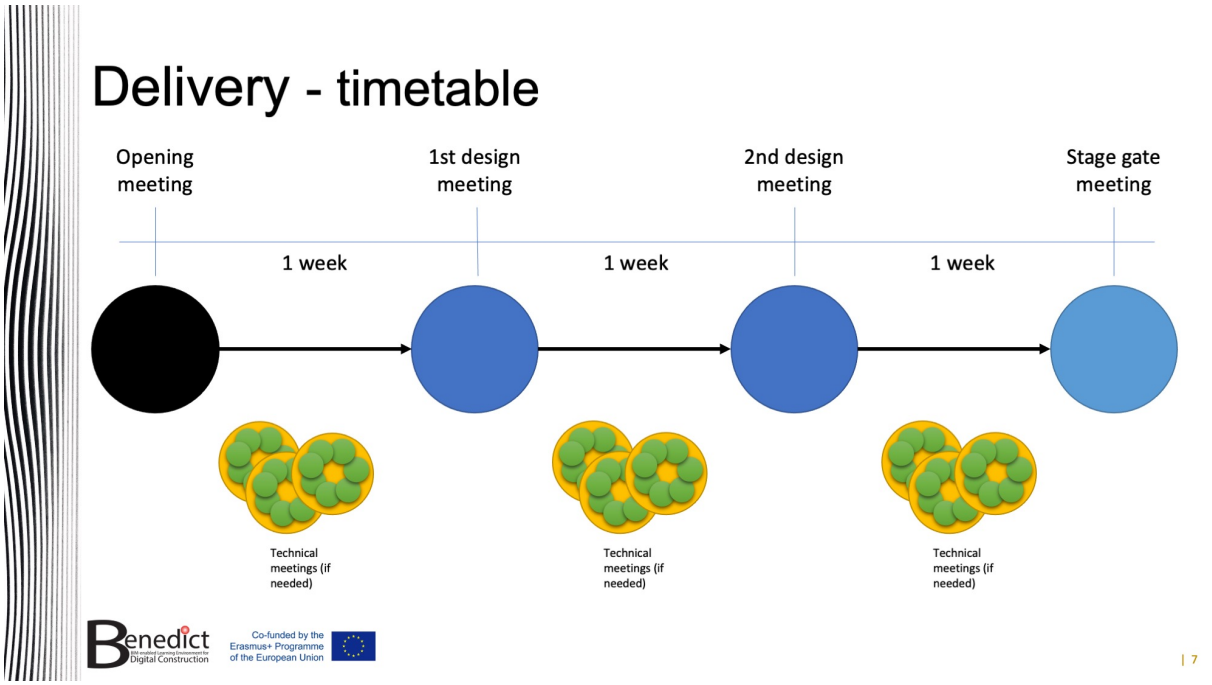
- Fully online
- Mixed online and on-campus
- Hybrid (some attending online and some on-campus)
- Fully on campus

Delivery - process, general

- Student will select one project role at the beginning of the implementation
- Student will follow the process for the selected project role and performs required tasks in their role
- Central for the delivery are meetings, which are run by the students

Delivery -process map





A.3. Introduction to the project

(From next page)

Tampere University

BIM-enabled Design Management at the concept design stage

Introduction to the project
Cheerleading Center

| 1

Tampere University

Location and the section

Location: Sellukatu 5, Block 2503, Section 5, Lielahti, Tampere

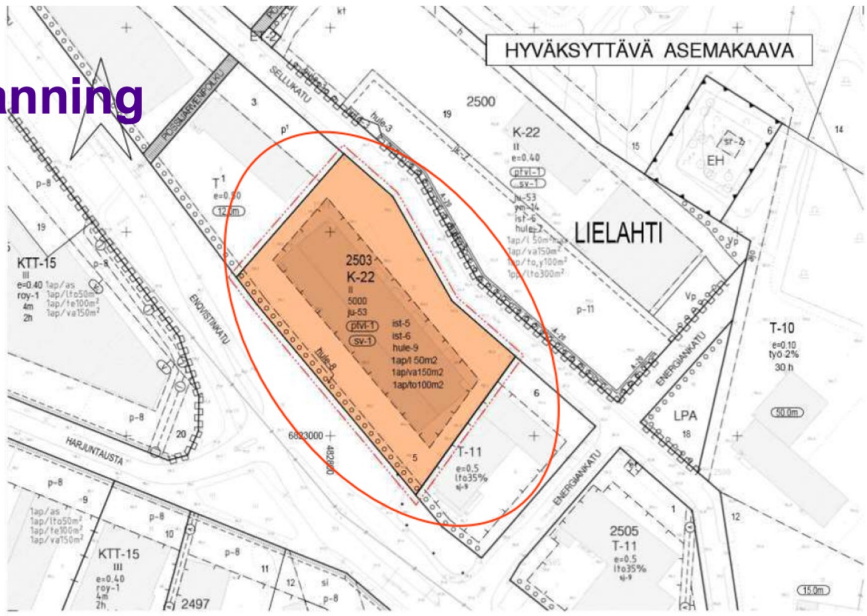
City planning: Permitted building area in the plan 5000 m2

Existing structures: Old retail/office building on the section

| 2

Tampere University

City planning



https://www.tampere.fi/ytoteto/aka/nahtavillaolevat/8125/8125.pdf

Tampere University

User

- Dream Team Cheerleaders DTC, Tampere
- 3 existing gyms
- >700 members
- 30 teams
- 65 coaches
- Cheerleading and Cheerdance
- Video from the National Championships

Spaces

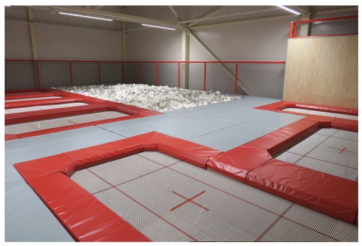
- Gym spaces for practice and competition
- Area for acrobatics and weight training
- Customer spaces (entry and toilets, shop, coffee shop)
- Office (5-6 desks) with a meeting room (10-12 people)
- Member spaces (locker rooms, showers, kitchen area)
- Storage area for dresses and equipment
- Building services/plant rooms
- Corridors
- External facilities

- Possibility to extend up to 5000 m2 in the future

Tampere University

Space use

- Week days mainly from 4 pm to 10 pm
- Weekends from 9 am to 9 pm
- Need for the weight training area 6 hours/week
- Summer break from Mid-Summer to the beginning of August
- Christmas break from 20th December to 5th January



Preliminary spatial programme

Use of space	Notes	Pieces	Area/space (m2)	Total (m2)
Competition hall	6-7 m free height	2	300	600
Training hall	5 m free height	2	150	300
Office space		2	10	20
Entrance hall		1	80	80
Cleaning room		1	10	10
Technical spaces	Needs to be divided in appropriate way (for example HVAC, TELE+ELECTRICITY)	1	160	160
Storage room		3	10	30
Civil defense shelter space		1	80	80
Toilet		8	3	24
Locker room (large)		2	30	60
Locker room (small)		2	10	20
Shower room		4	10	40
Cafe space		1	80	80
Kitchen (cafe)		1	10	10
Gym		1	160	160
Conference room		1	20	20
			TOTAL:	**1694 m2**

External
Staff, member and customer parking
Waset management
Drop-off areas

Appendix B – Activity Materials

B.1. BIM intro quiz

(From next page)

TERMINOLOGY QUIZ

BIM

WHAT DOES THE ACRONYM MEAN

In this section you need to specify
what each given acronym means

BIM

A. Building Information Model
B. Building Information Modelling
C. Building Information Management
D. Better Information Management

VDC

A. Virtual Design and Construction
B. Visual Design and Construction
C. Value Development Project
D. Value Design Component

ACRONYMS VDC AND BIM SPELL OUT AS

- **VDC** = Virtual Design and Construction

- **BIM**
- = Building Information Model
- = Building Information Modelling
- = Building Information Management

BIM DEFINITIONS

- **Building Information Model (BIM) (Product)** – an object-based digital representation of the physical and functional characteristics of a facility. The Building Information Model serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life cycle from inception onward.

- **Building Information Modelling (BIM) (Process)** – a collection of defined model uses, workflows, and modelling methods used to achieve specific, repeatable, and reliable information results from the model. Modelling methods affect the quality of the information generated from the model. When and why a model is used and shared impacts on the effective and efficient use of BIM for desired project outcomes and decision support.

- **Building Information Management (Data Definition)** – Building Information Management supports the data standards and data requirements for BIM use. Data continuity allows for the reliable exchange of information in a context where both sender and receiver understand the information.

- NZ BIM Handbook (2019)

...BIM DEFINITIONS

BIM is essentially value creating collaboration through the entire life-cycle of an asset, underpinned by the creation, collation and exchange of shared 3D models and intelligent, structured data attached to them. (BIM Task Group UK)

Building Information Modelling (BIM) is a set of interacting policies, processes and technologies generating a methodology to manage the essential building design and project data in digital format throughout the building's life-cycle (Penttila, 2006)

buildingSmart defines BIM as follows: "BIM is a digital representation of the physical and functional characteristics of a building. As such, it serves as a shared knowledge resource for information about a building, forming a reliable basis for decisions during its lifecycle from inception

Wikipedia defines Building Information Modeling (BIM) as the process of generating and managing building data during its life cycle using three-dimensional, real-time, dynamic building modelling software to decrease wasted time and resources in building design and construction.

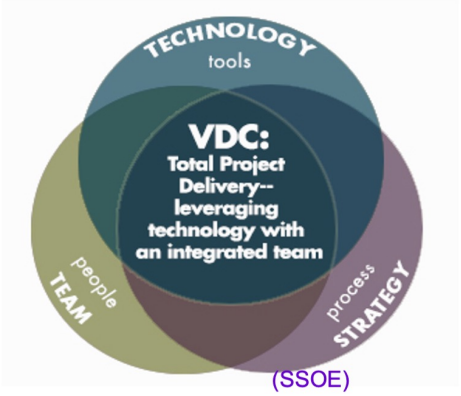
The US National Building Information Model Standard Project Committee has the following definition for BIM: Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.

BIM is an intelligent model-based process that provides insight to help you plan, design, construct, and manage buildings and infrastructure. (Autodesk)

Building Information Modelling is the process of designing, constructing or operating a building or infrastructure asset using electronic object-oriented information (as defined by PAS 1192-2:2013)

Greg Bentley, CEO of Bentley Systems, began his address to BIM users in a BIM technology conference with his own definition.
- "B" he said was for "better decisions from a depth of information modeling (via simulation + visualization)
- "IM" he said stood for "information mobility for better performing projects." That is, how well users can obtain better collaboration through mobile platforms and apps

VDC DEFINITIONS



Virtual Design and Construction (VDC) is the management of integrated multi-disciplinary performance models of **design-construction** projects, including the product (i.e., facilities), work processes and organization of the **design -construction** - operation team in order to support explicit and public business objectives ... (Wikipedia)

Virtual Design and Construction is essentially building the entire project virtually (digitally) before it is built in the real world. (Civil FX)

Virtual Design and Construction (VDC1) is the use of integrated multi-disciplinary performance models of design-construction projects to support explicit and public business objectives. (Stanford University)

GIS

A. Geographic Information System
B. Graphical Information System
C. Geographic Information Specification
D. Graphical Information Specification

IFC

A. Integrated Facility Coordination
B. Industry Founded Classification
C. Intelligent Facility Classification
D. Industry Foundation Classes

MULTITUDE OF SOFTWARE FOR DIFFERENT PURPOSES

- Model authoring tools (architecture, structural, building services): AutoCAD Civil 3D, Revit, ArchiCAD, Bentley, Tekla Structures…
- Simulation and analysis tools: Navisworks, Synchro, Solibri Model Checker, Green Building Studio, Energy Plus, Vico Office, CostX…
- Shop drawing and fabrication tools: Tekla Structures, Revit MEP, SDS/2…
- Viewers/Collaboration tools: Timble Connect/FieldSight/BIMSight, Autodesk BIM 360 Field, ProjectWise, ArchiCAD Teamwork, Aconex, Solibri Model Viewer, Navisworks Freedom…

LEARN MORE ABOUT IFC

What is IFC? (video by BIM Secrets, 2:44 min., https://www.youtube.com/watch?v=cDpJffnpJHI)

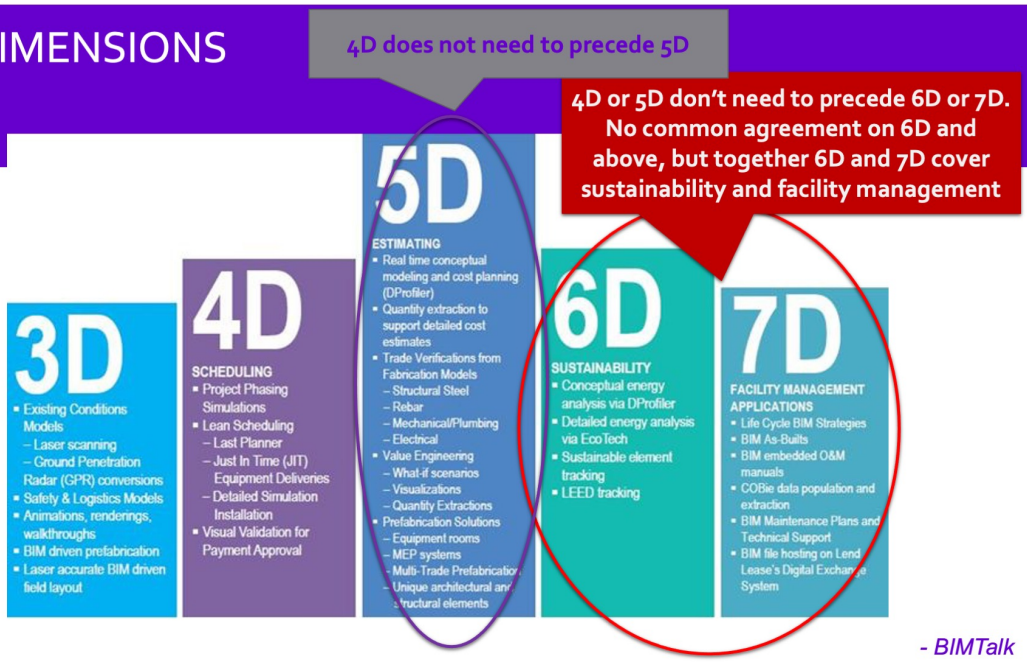
TERMINOLOGY

In this section you need to specify
what each given term means

4D BIM

A. Uses BIM to layout building components on site
B. Is a process where team develops a 3D model of the site
C. Is a 3D BIM model combined with a time element
D. Is a BIM model combined with cost elements

BIM DIMENSIONS



- BIMTalk

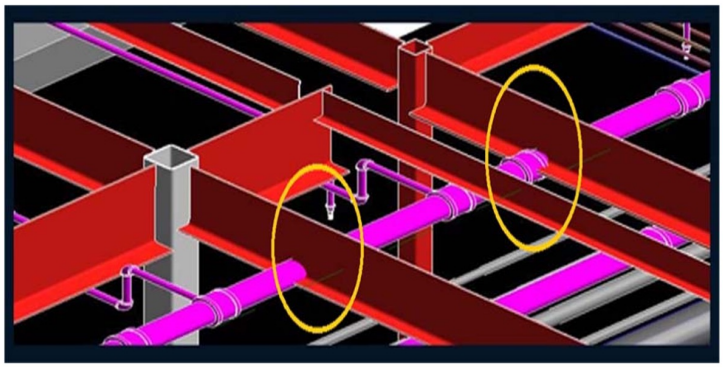
WHAT ARE THE FOUR KEY ELEMENTS OF BIM?

A. Computers, software, designers and documentation
B. People, policy, technology and process
C. Operations, construction, transition and design and planning
D. 1D BIM, 2D BIM, 3D BIM and 4D BIM

WHAT IS IN THE PICTURE?

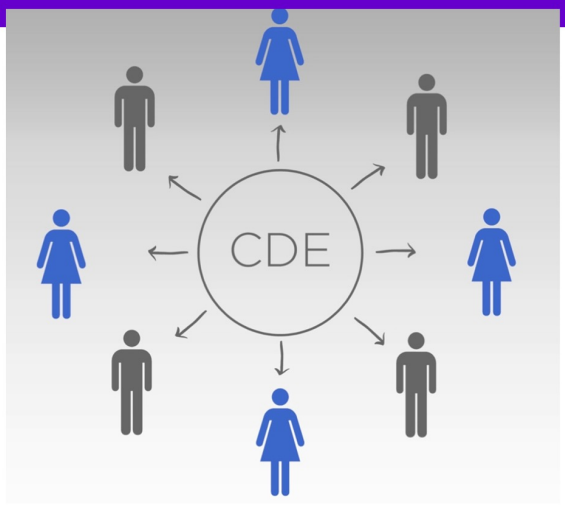
In this section you need to be able to identify what you see in the picture

WHAT IS IN THIS PICTURE?



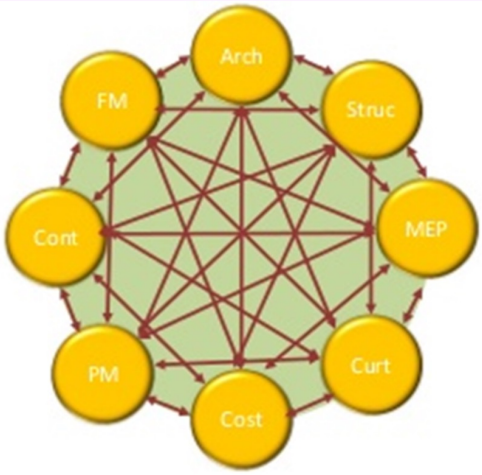
A. Architecture clashing with building services
B. Building services clashing with structure
C. Structure clashing with architecture
D. Structure clashing with structure

WHAT IS IN THIS PICTURE?



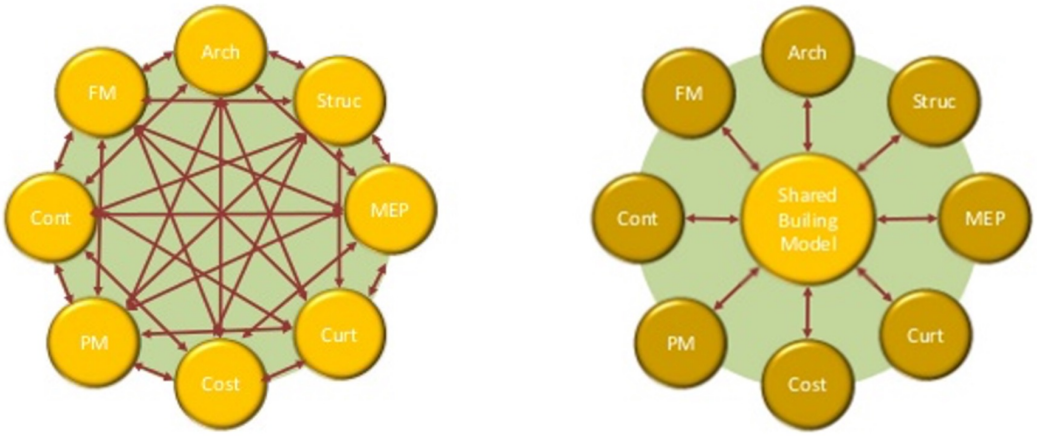
A. Construction and Design Environment
B. Common Data Environment
C. Construction, Design and Engineering
D. Common Design Environment

WHAT IS IN THIS PICTURE?



A. BIM project collaboration process
B. Traditional project collaboration process
C. Integrated project delivery process
D. Integrated design and delivery system

COLLABORATION



- *buildingSMART, 2014*

WHAT IS IN THIS PICTURE?

A. Building Information Model
B. Virtual Design and Construction
C. Parametric model
D. Image of a building

Appendix C – Assessment Materials

C.1. Feedback questions

(From next page)

1. What did you like about the Design management simulation?
2. What did not work well in the DM simulation?
3. Was there enough guidance or resources for you to complete your tasks in your role? If not, tell what could have been added/improved.
4. How did the collaboration and communication work with other students (e.g. other roles in the project)?
5. Any other comments or suggestions for improvements?