Module 9

Roles and Knowledge Transfers

Digitalisation in Construction

Date of Event

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To equip the learner with the relevant knowledge and skills required to understand different roles and how information is managed during the BIM process and digitally transferred on completion of works

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1. Outline the importance of collating accurate digital information and knowledge transfer between the design, construction and maintenance teams.
2. Outline the importance of digital knowledge transfer to the building owners and occupants
3. Outline and understand the roles of each member of the construction team during construction when using the BIM model
4. Identify and outline good practice steps to transfer knowledge using digital tools during each phase of construction.
5. Demonstrate the extraction and inclusion of information from models for the purposes of checking the design, details and construction work
6. Identify and outline good practice steps to transfer knowledge using digital tools at completion of the construction works and for the future life of the building
7. Outline the importance and benefits of having accurate digital building information at handover stage.
8. Demonstrate how knowledge is transferred using digital tools at completion of the construction works

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Topic 1 – Roles

Topic 2 – BIM and file structure

Topic 3 – Digital workflows

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1. Roles

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Internal vs External Collaboration

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- **Internal:** Between staff within an organization.

- **External:** Between those within the company and those in the outside world.

- What happens when internal audiences include external people?

- Which channels of Collaboration do we use? Face-to-face, email, online, phone, etc.

- How much time do we spend collaborating on a daily basis?

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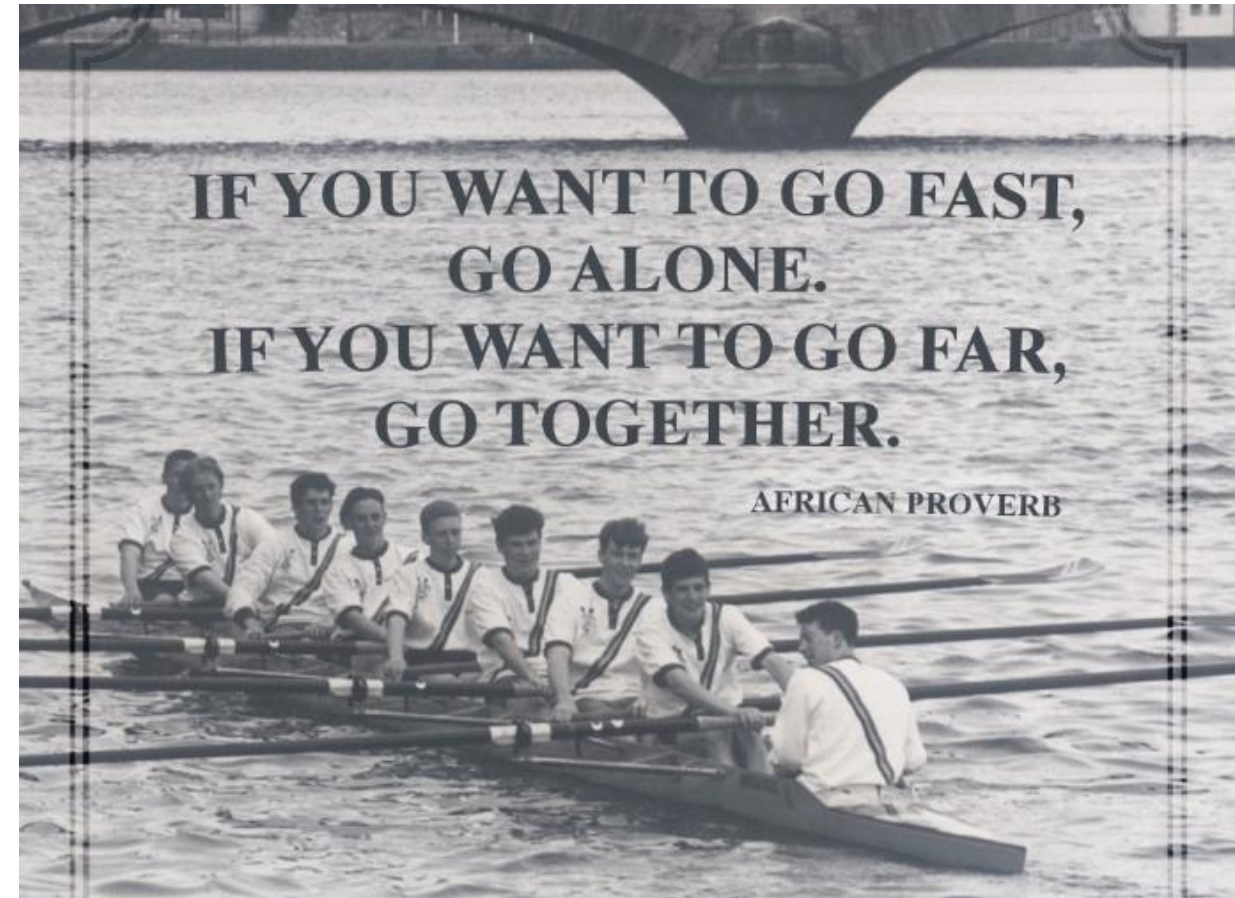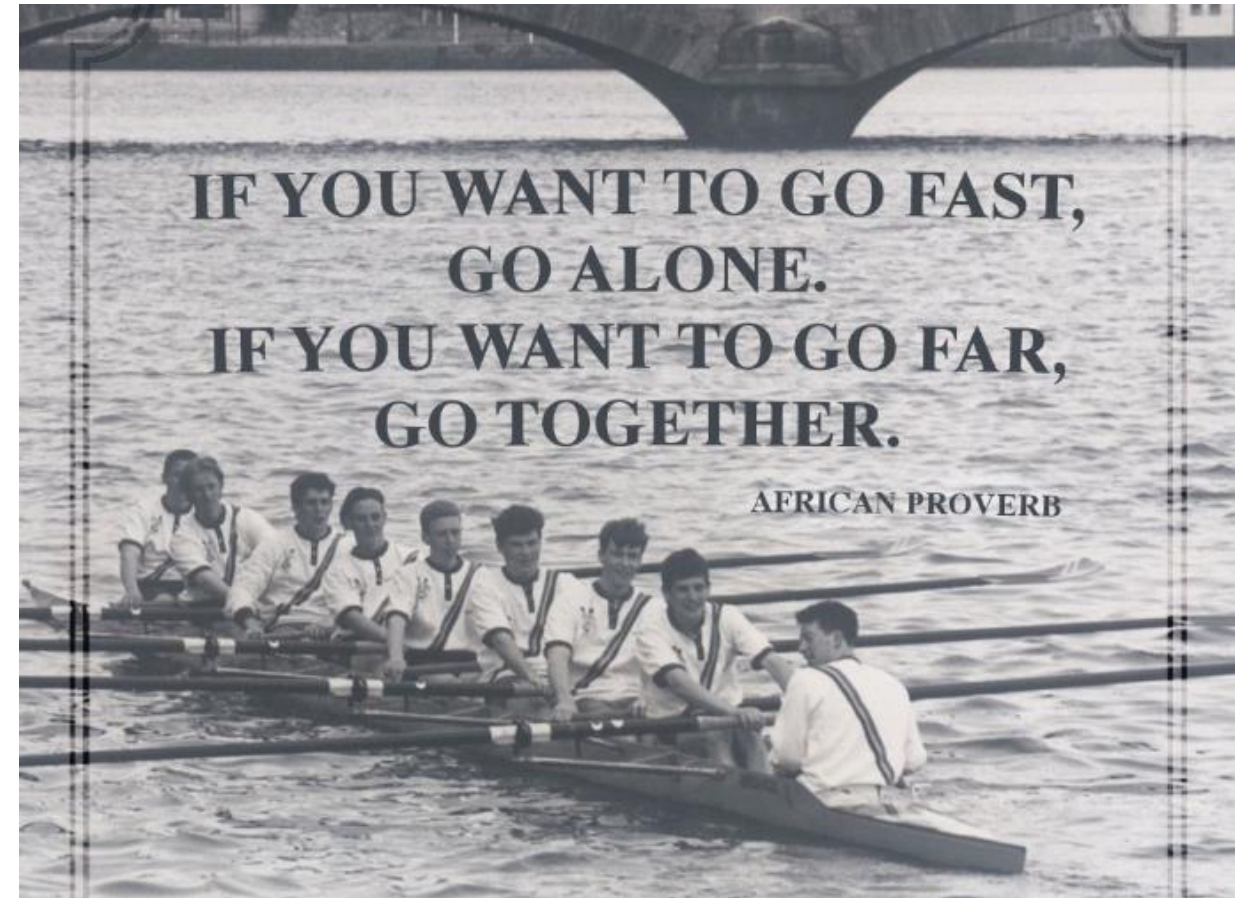Ollscoil Teicneolaíochta na Sionainne:
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- Is it possible to collaborate without communication?

- Are lines of internal and external communications clear? Or are they often blurred?

- Do we communicate in an efficient way?

- Is the communication standardised?

IF YOU WANT TO GO FAST, GO ALONE. IF YOU WANT TO GO FAR, GO TOGETHER.

AFRICAN PROVERB

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Collaboration - Communication

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Roles & Responsibilities -Team Members

- **BUILDING OWNER:** provide definition and scope, budget and scheduling information, decision-making power.

- **ARCHITECT:** Expertise that unites structural, civil, mechanical and electrical goals.

- **ENGINEER:** Mechanical electrical and plumbing systems, structural analysis and design. Code compliance.

- **INTERIOR DESIGNER:** Non-load-bearing interior construction.

- **CONTRACTOR:** Construction of the Project.

- **OTHER MEMBERS:** Cost Estimators/ Landscape Architects/ Construction Managers/ Site Supervisor.

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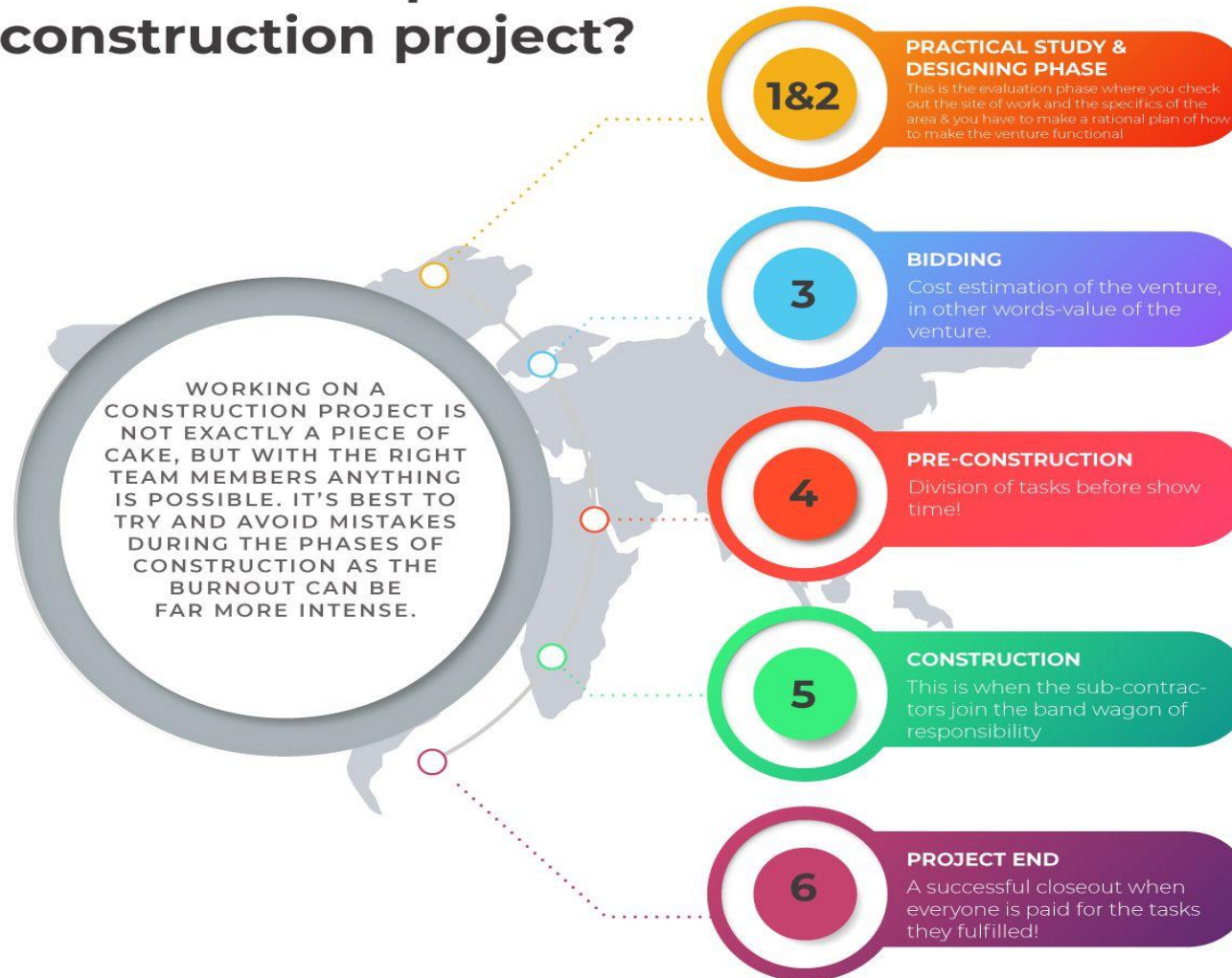Ollscoil Teicneolaíochta na Sionainne:
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What are the phases of a construction project?

WORKING ON A CONSTRUCTION PROJECT IS NOT EXACTLY A PIECE OF CAKE, BUT WITH THE RIGHT TEAM MEMBERS ANYTHING IS POSSIBLE. IT'S BEST TO TRY AND AVOID MISTAKES DURING THE PHASES OF CONSTRUCTION AS THE BURNOUT CAN BE FAR MORE INTENSE.

1&2 PRACTICAL STUDY & DESIGNING PHASE
This is the evaluation phase where you check out the site of work and the specifics of the area & you have to make a rational plan of how to make the venture functional

3 BIDDING
Cost estimation of the venture, in other words-value of the venture.

4 PRE-CONSTRUCTION
Division of tasks before show time!

5 CONSTRUCTION
This is when the sub-contractors join the band wagon of responsibility

6 PROJECT END
A successful closeout when everyone is paid for the tasks they fulfilled!

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Matrix of Roles & Responsibilities

- **Effective information management** requires clear roles, responsibilities and definition of authority levels.
- **BIM Perspective:** The Responsibility Matrix defines the responsibility for the production of information and models for each project phase. Constant WIP document.
- **RACI indicators:**
- R (responsible)
- A (authoring)
- C (contributing)
- I (informed)

RACI Matrix

Task \ Role	Role 1	Role 2	Role 3	Role 4	Role 5	Role 6
Task 1	R		C			
Task 2	R		A		C	
Task 3	R	R	I	A		I
Task 4			C		R	
Task 5	A	C		I		
Task 6		I	C	C		R

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Matrix of Roles & Responsibilities

Deliverable	Project Manager	Technical Load	Architect	Contractor	Sub-Contractor	Client
Approved Project Brief	AR	C				C
Approved Project Plan	AR	C	I			I
Completed Requirements	A	C	R	I	I	C
Approved Drawings	A	C	R	C	C	C
Completed Site Survey	A	R	I	C	C	I

RACI matrix example

	R	Responsible
	A	Accountable
	C	Consulted
	I	Informed

Project Activity / Deliverable	Project Manager	Consultant	Architect	Contractor	Client
Define functional and aesthetic needs	I	I	C	I	R
Assess risk	A	R	I	C	I
Define performance requirements	A	R	I	I	I
Create design	A	C	R	I	C
Execute construction	A	C	C	R	I
Approve construction work	I	I	C	C	R

Area of focus	PROJECT ROLES											
	Global content writer(s)	Regional writer(s)	Translator	Graphic designer	Photographer	Videographer	Front-end developer	Web analyst	Subject Matter Expert *	Digital director	Quality Assurance	Producer or PM
Write content (Global)	R	C	C	I	I	I	I	I	C	A	-	I
Write content (Regional)	I	R	C	I	I	I	I	I	C	A	-	I
Translated content	I	C	R	I	I	I	I	I	I	A	-	I
Graphics & visual design	I	I	I	R	I	I	I	I	C	A	-	I
Create photos	I	I	I	I	R	I	I	I	C	A	-	I
Create videos	I	I	I	I	I	R	I	I	C	A	-	I
Create page layouts	C	C	I	I	-	-	R	-	I	C	-	I
Create page templates	C	C	I	I	-	-	I	-	I	C	-	I
Analytic set up	I	I	I	-	-	-	-	R	-	C	-	I
Content accuracy	R	R	R	R	R	R	-	-	A	I	-	I
Experience strategy	R	R	R	R	R	R	R	I	I	C	-	I
Content quality & brand	R	R	R	R	R	R	R	I	I	A	-	I
Web readiness	R	R	R	R	R	R	-	-	-	C	A	I
Project management	C	C	C	C	C	C	C	C	C	A	-	R
Final approvals & publishing	C	C	C	C	C	C	C	C	C	A	C	I

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Common Data Environment (CDE)

Common data environment (CDE): central source of information for involved parties.

Whereas in traditional projects information is shared directly from one participant to another, BIM promotes the use of a Common Data Environment for improved information flow between everyone.

Traditional

BIM

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Roles

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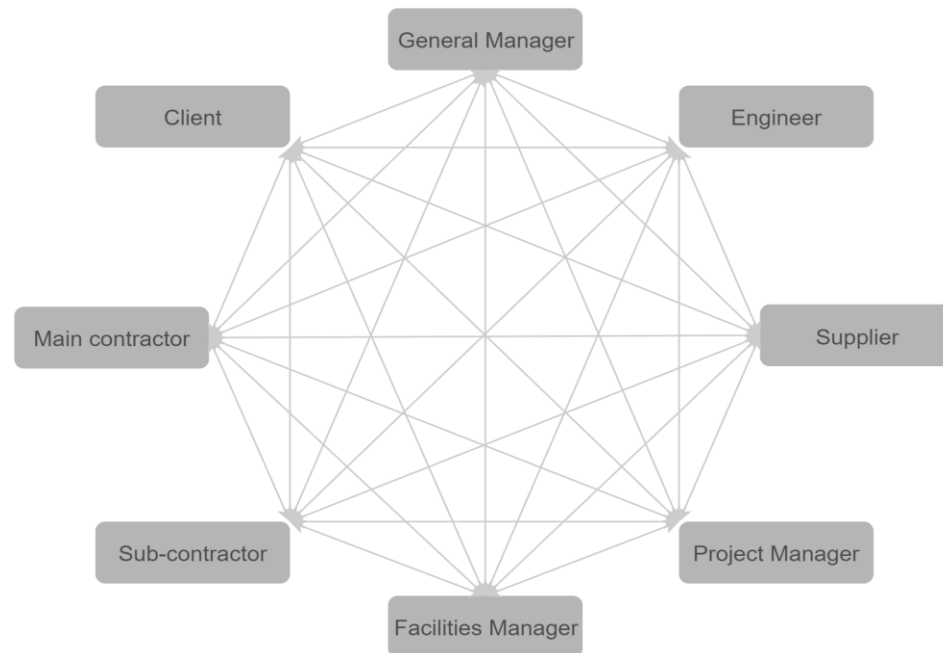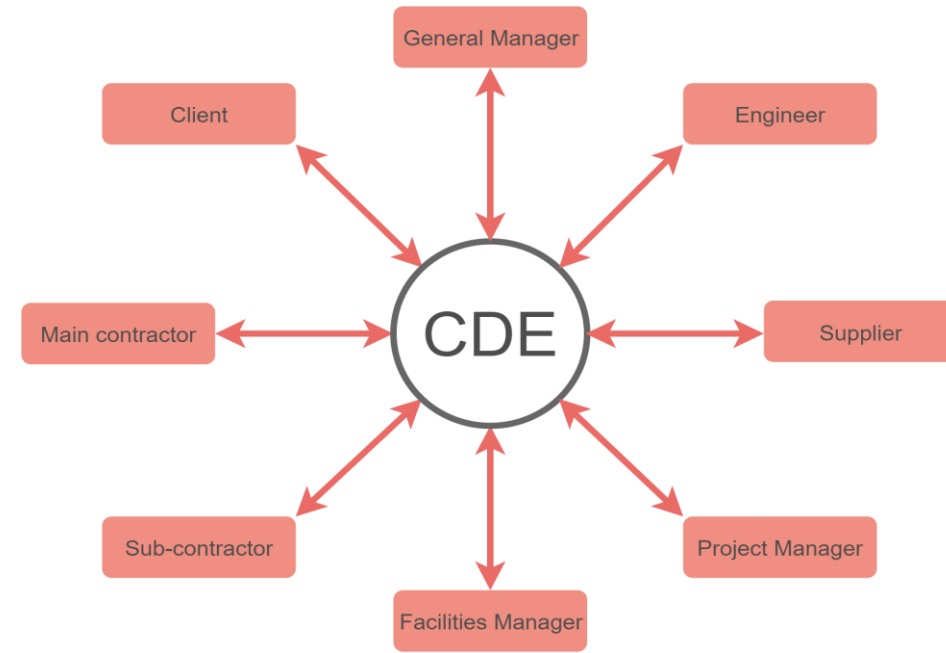
According to the National BIM Report 2014, the lack of in-house expertise is one of the main barriers to BIM implementation.

In order to collaborate, construction companies need to provide BIM training for the workforce.

But most important is the openness of the staff towards new technologies and self-development.

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Roles

BIM Project Participants

BIM introduces new processes, technologies and policies led to a need for specialized professionals.

In reality, some of the responsibilities can be taken on by the same professional.

Among these, the most common are BIM manager, coordinator and modeller.

Data Manager for BIM

Employer's BIM adviser

BIM information manager

BIM manager

BIM coordinator

BIM modeller

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The built environment-related educational requirements have been changing in order to meet emerging needs and new professions were created in terms of BIM-related topics.

BIM manager	**BIM coordinator**	**BIM modeller**
Employer's BIM adviser	**BIM information manager**	**Data manager for BIM**

Click on the buttons, to learn more about the professions

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Responsibilities and tasks carried out by the BIM Manager, BIM Coordinator and BIM Modeler

Role	Strategic						Management				Production	
	Corporate Objectives	Research	Process + Workflow	Standards	Implementation	Training	Exceution Plan	Model Audit	Model Coordination	Content Creation	Modelling	Drawing Production
BIM Manager	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N
BIM Coordinator	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N
BIM Modeler	N	N	N	N	N	N	N	N	N	Y	Y	Y

9 Responsibilities of the BIM Manager, BIM Coordinator and BIM Modeler (based on AEC UK, 2012a)

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Source: SiBIM project

Roles

BIM technologies are used during the whole lifecycle of a construction project, which includes tendering, scheduling, financial management, contract management, procurement and construction. Employees need to adapt to the changes brought by new technologies.

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Roles

Design Manager

Design manager communicates with the designers and is responsible for the digital design documentation.

They connect the design office to the building site.

They need to be able to work and exchange data with IFC models and prepare contracts.

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Roles

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Project manager and Engineer

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Project manager and and Engineer operate 3D BIM models, plan the work processes and all subsequent phases.

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Roles

Site manager

Site managers operate the BIM model, find and interpret the data and information they need.

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Roles

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Surveyor

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Surveyors use 3D models to position, orientate and level the structure on the site.

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Roles

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Construction worker

Construction workers and Trades may require training to understand BIM tools and techniques.

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Roles

Health and safety specialist

Source: SiBIM project

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Health and safety specialists require skills about model orientation and presentation of different construction phases.

Please watch the following video:

4D Safety Planning using 3D Reepo with Freeform 3D

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Roles

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Construction Manager

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Construction Managers deal with the financial aspects of construction and use the data and documentation management system to ascertain the current status of the project.

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BIM Execution Plan (BEP)

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BIM Execution Plan (BEP) is a guideline document which forms the basis for BIM collaboration
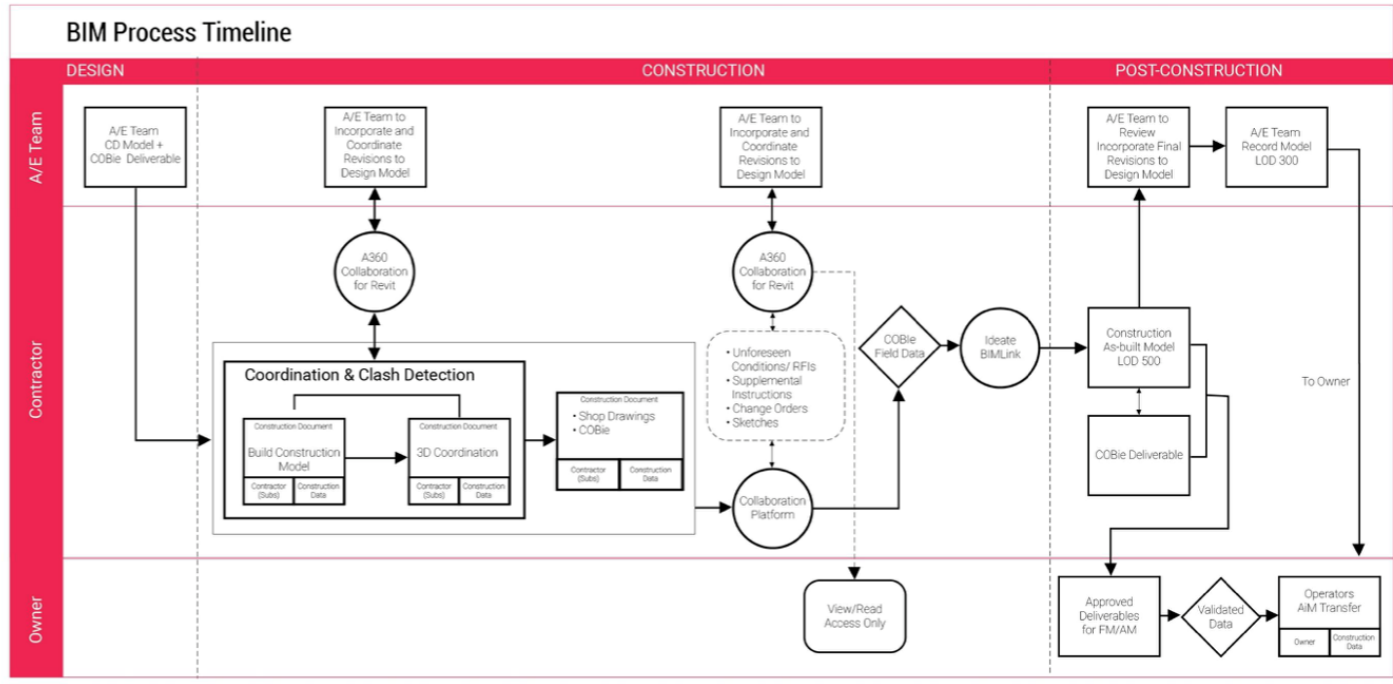
BEP is:

- A definition of organisational structures and responsibilities

- The framework for BIM performance

- A definition of processes and requirements for collaboration

- A description of unified approach for structures and elements

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Image source United BIM

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BIM EXECUTION PLAN

All these roles, responsibilities, decisions, etc... must be agreed upon by all members of the Project team. Once agreed it is necessary to write them all in a contractual document where each individual agent can find their responsibilities and information requirements to ensure interoperability (and other workflows) and to achieve the Project BIM objectives.
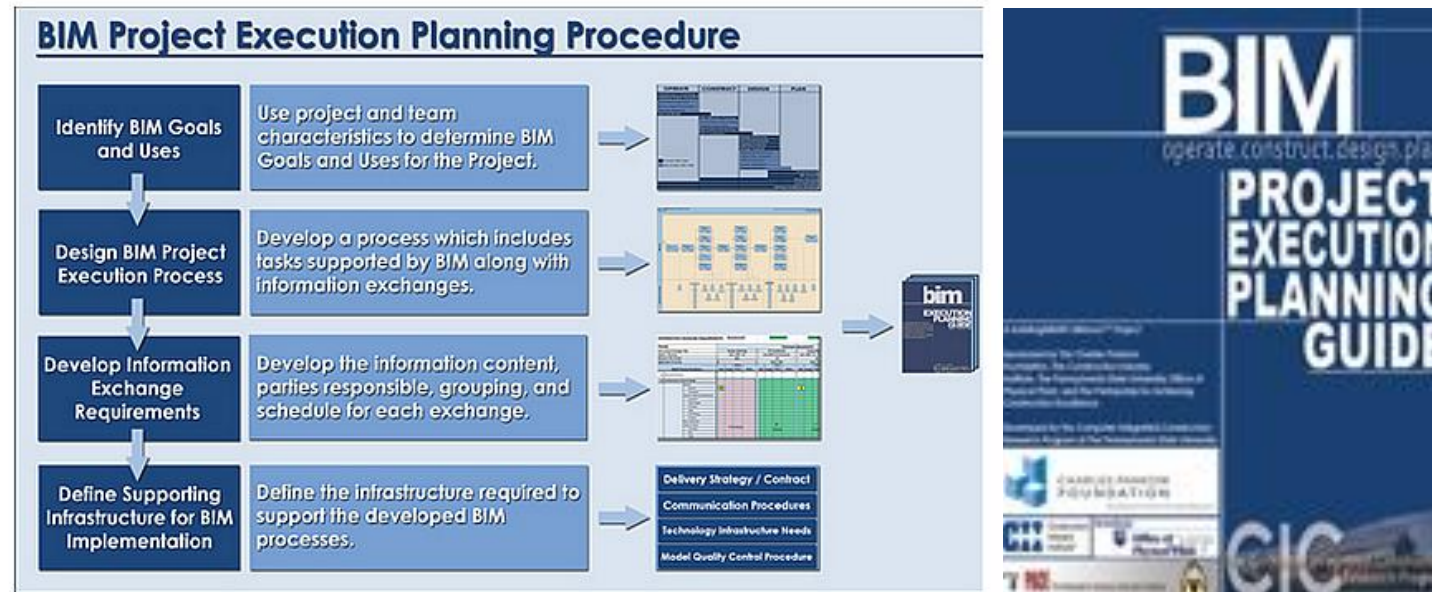
Image: BIM Project Execution Planning Guide (PSU)

BIM Execution Plan

BIM EXECUTION PLAN

At tender stage, before a contract is agreed, a prospective supplier will develop a BEP with the aim of demonstrating their proposed approach, capability, capacity and competence to meet the EIR in general terms.

Once a contract has been awarded then the winning supplier is required to submit a further BIM Execution Plan. The focus of this post-contract document is to confirm the supply chain's capabilities.
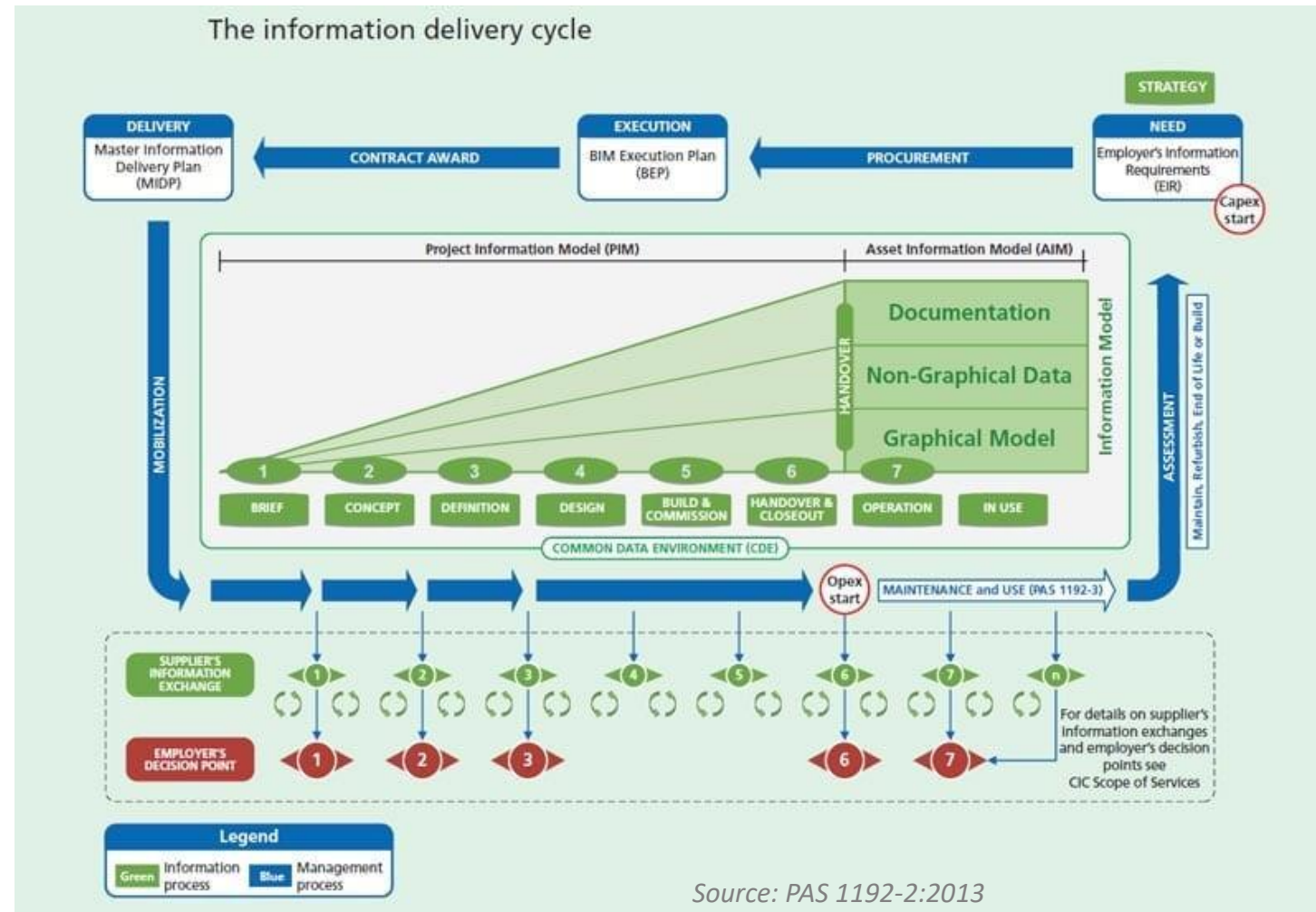
Source: PAS 1192-2:2013

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Source: BIMzeED project

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BIM Execution Plan (BEP)

Steps of BEP

Step 1

Define project information

- Basic design information

- Main team members and BIM managers

- Project milestones

Step 2

Set project BIM goals

- Increase of competence of project team

- Increase project performance and security

- Increase quality of the project

Step 3

Choose BIM uses (examples)

- Planning phase (situation modelling and analysis)

- Design phase (3D coordination)

- Construction phase (fabrication)

- Operational phase (monitor maintenance)

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Creating a BEP

Click here to watch video

Video by Plannerly - The BIM Management Platform

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BIM Execution Plan (BEP)

Post contract BEP: This sets out how the required information in the EIR will be provided.

Includes:

- Management (roles, responsibilities, milestones, deliverables and survey strategy and legacy data use)

- Planning and documentation (revised project implementation plan, agreed processes for collaboration and modelling, matrix of responsibilities, task and master information delivery plan)

- Standard method and procedure (volume strategy, file and layer naming, construction tolerances and attribute data)

- IT-solutions (software and exchange formats)

Example linked HERE

Image source Deloitte

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Employer's Information Requirement (EIR)

Pre Contract BEP is a direct response to the Employer´s Information Requirement (EIR)

Employer's Information Requirements

Technical
- Software platforms
- Data exchange format
- Co-ordinates
- Level of detail (general)
- Level of detail (components)
- Training

Management
- Standards
- Stakeholder roles and responsibilities
- Planning the work and data segregation
- Security
- Coordination and clash detection process
- Collaboration process
- Model review meetings
- Health and safety and construction and design management
- System performance constraints
- Compliance plan
- Delivery strategy for assets information

Commercial
- Timing of data drops
- Clients strategic purpose
- Defined BIM/project deliverables
- BIM-specific competence assessment

Image source   Building Radar

It includes:
- Project implementation plan, which sets out capabilities, competences and experiences of potential suppliers
- Goals for collaboration and information modelling
- Project milestones in line with the project programme

Example linked HERE

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2. BIM and file structure

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➢ **Information and communications technology (ICT) skills refers the ability to communicate with people by various digital technologies.**

➢ ICT relates to use of technology regularly for everyday tasks: email, video call, browsing the internet, download a file, using a tablet or mobile phone, and more.

➢ As more and more digital tasks involving collaboration and communication permeate our daily lives, but more importantly our jobs, knowledge of some basic digital procedures is essential.

➢ One of the most important concepts, to enable efficient communication and productivity is **file management.**

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Source: BIMcert project

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Why is proper file management important?

The goal of a proper file management procedure it to allow:

- Find data easily
- Identifying data easily
- Avoid loss of data

➤ Traditionally, we would file information into physical folders and cabinets for record and safekeeping purposes.

➤ **We would organise them into sections and probably either alphabetically, chronologically or another effective form of categorising and filtering, in order to be able to search and find the required information easily**.

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Why is proper file management important?

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➢ The same principles apply to digital data.
➢ If we do not follow proper file management procedures, we run the risk of:

1. data loss and misplacement,
2. losing time trying to find data,
3. miscommunication.

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How data should be organised

In common terms, digital data that we access on our daily task follow the decreasing order hierarchy:

1. **Drives –** overall place of storage. Usually represented by directories
2. **Directories –** within directories you have folders
3. **Folders –** within folders you have various sub folders
4. **Subfolders –** within folders or subfolders you have actual files that allow you to do your actions
5. **Files --** these can be
   - **A set of files to allow a programme to operate**
   - a "native" file – files created and open by specific software to allow user to open, interact, edit information . Each software usually as its own native file

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Drives/Directories- format as followed
C:

Folders -name of the folder, followed by backslash
folder

Files-Digital files are usual determine by an " extension" after the name. That extension is usually in the format of a dot, followed by three letters. Examples:

- **.pdf**
- **.rfa**
- **.rvt**
- **.doc**
- **.xls**

Each software will have its own native file extensions. so depending on the three letters, we are able to identify to which software that file belongs to.

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Roles and Knowledge Transfer

Source: BIMcert project

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➢ All files should be saved under an appropriate folder and subfolder.

➢ Associated files should be in same or inter dependent location (within other folders too).

➢ All files and folders must be properly named, allowing identification of the data contained within them. This helps users to easily find and identify the data (file) they require.

➢ Conventional recognised Industry **File Naming Standards** should be used.

➢ Or, at least, as some organisations do, an internally agreed standardised method, allowing all user to easily identify the information, such as the type of data store in them, authors, version saved, etc.

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Roles and Knowledge Transfer

Source: BIMcert project

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BIM naming conventions

> ➤ In the case of BIM files (3D modules and any other file relevant to the project) , there are a set of standards that should be used, when naming files and placing them in the common data environment (CDE).

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Avoiding data loss

➢ When dealing with native files (usually generated by users own work operating a software), **regular saves should be undertaken, to ensure the last data is being recorded.**

➢ To ensure that, in case of data loss or corruption of original file, we have an extra record that we can use to recover the information, **Backups (copies of these files) should be made regularly.** If possible, set them up to be created automatically by the software at regular intervals (if software allows this option).

➢ These files should be save into identified folders.
Both the files and backup files should have clear identifiable names.

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Source: BIMcert project

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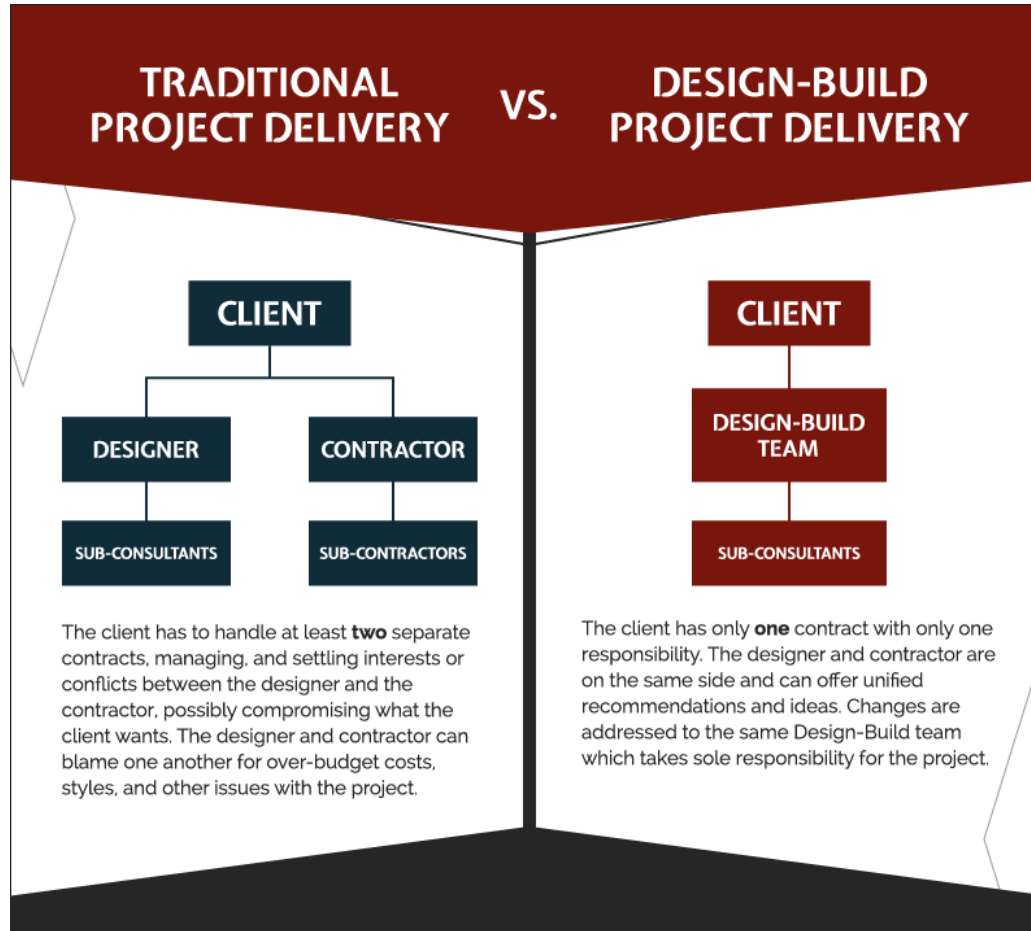Ollscoil Teicneolaíochta na Sionainne:
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File management conclusion

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The good file **management** practice and use of appropriate **naming convention** standard is key to understand and operate effectively and productively in the CDE environment.

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3. Digital Workflows

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TRADITIONAL PROJECT DELIVERY VS. **DESIGN-BUILD PROJECT DELIVERY**

CLIENT
DESIGNER — CONTRACTOR
SUB-CONSULTANTS — SUB-CONTRACTORS

The client has to handle at least **two** separate contracts, managing, and settling interests or conflicts between the designer and the contractor, possibly compromising what the client wants. The designer and contractor can blame one another for over-budget costs, styles, and other issues with the project.

CLIENT
DESIGN-BUILD TEAM
SUB-CONSULTANTS

The client has only **one** contract with only one responsibility. The designer and contractor are on the same side and can offer unified recommendations and ideas. Changes are addressed to the same Design-Build team which takes sole responsibility for the project.

■ **TRADITIONAL PROJECT**

1. Design Stage
2. Bidding Stage
3. Construction Stage

■ **DESIGN-BUILD PROJECT**

1. Bidding Stage
2. Design and Build Stage
3. Collaboration between designing and building aspects
4. Single point of contact

Digitalisation in Construction:
Roles and Knowledge Transfer

Source: BIMzeED project

Workflow - Contract & BIM Execution Plan

- **EMPLOYER REQUIREMENTS/ EXPECTATIONS**
- Implications of BIM on all phases
- **LEGAL IMPLICATIONS**
- Models as the main source of information?
- Ask for a Clash-free Model?
- Design Responsibility: How many stakeholders will work on the project?
- Development of BIM: Will employer be involved?
- Deliverables

- **BIM USES**
- **ORGANIZATIONAL CHARTS AND RESPONSIBILITY TRACKING**
- **SHARED DELIVERABLES**
- Join work by two or more consultants, discipline coordination drawings

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Source: BIMzeED project

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Workflow - Design

KEY METRICS:

- Architectural and Geometrical Quality
- Function
- Cost

■ "BIM and computational design tools offer a great opportunity to capture geometrical and program constraints within the design and detailing process, as well as capture and manage functional, material and operational features"

KEY POINTS:

■ Document Control (Naming, versioning, standards)

■ Codification Systems

■ Model Breakdown Structure over Phases

■ Common Data Environment (WIP/SHARED/PUBLISHED)

■ Collaborative Editing

■ Model Quality

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Workflow - Construction

- Who is the **owner of the Model** during Construction?
- Which **information** does a **BIM As-Built** contain?
- How are **changes implemented** in the Model?
- How are **change orders** managed?
- How are **construction drawings** integrated in the BIM Model?
- Which **tools** are used for **monitoring cost and planning**?

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Source: BIMzeED project

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Workflow - Operations & Maintenance

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- We must understand client needs.
- Each client has different needs that require different structures of information.
- Analyze future uses of the models in operations phase.
- You need to know how the information will be used and maintained.
- You cannot manage what you don't know.
- The information needs maintenance in order to be valuable.
- Design the relation between databases in order to transfer information between platforms.

- **WHAT BIM FOR FM MEANS?**
- **HOW DO WE DESIGN THE CONNECTION OF BIM DATA WITH FM PLATFORMS?**

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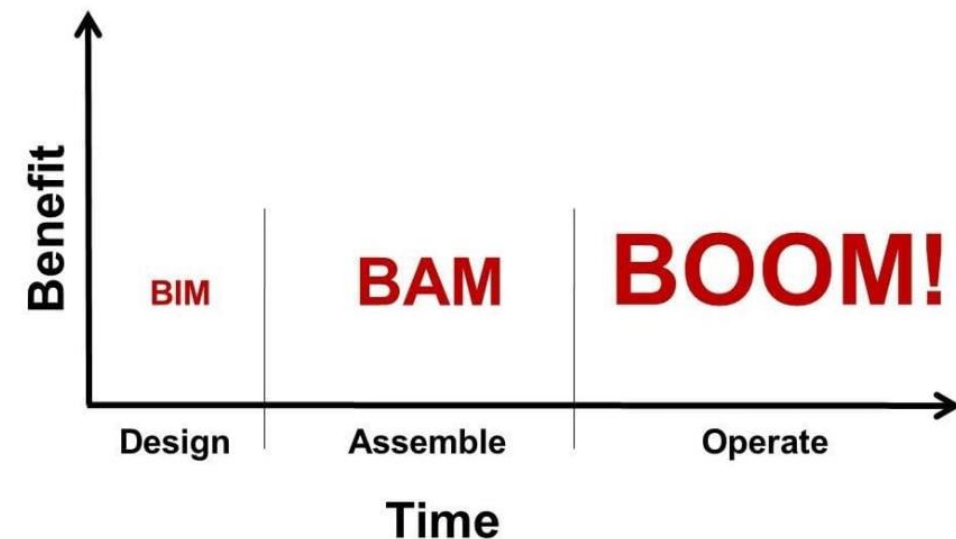
■ **MANAGEMENT ADVANTAGES OF THE DIGITAL TWIN of the Facility:**

- Single source of information

- Interoperability

- 3D Visualization

■ Keep all digital data related to a building in a single repository and make the most of it when it comes to planning, reporting and updating.

■ **TYPES OF FM BIM MODELS:**

- Evolution from a Construction Project.

- Created from scratch during the Operation Phase.

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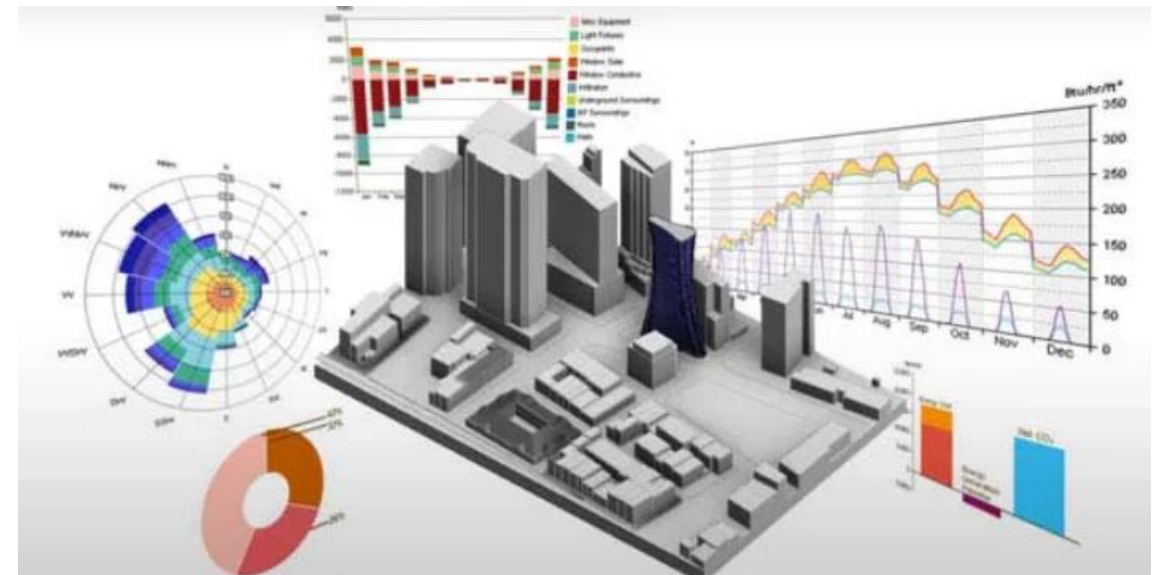
BIM Roles

Carrying out a project in BIM implies having to take care of the models we make. Because if they are not made with the right strategy, they can be useless and the effort dedicated to make them would be in vain.

That is why new responsibilities must be acquired in order to guarantee the success of the application of the BIM methodology.

These new roles are:
- BIM Manager
- BIM Coordinator
- BIM Modeler

Role	Strategic						Management				Production	
	Corporate Objectives	Research	Process + Workflow	Standards	Implementation	Training	Exceution Plan	Model Audit	Model Coordination	Content Creation	Modelling	Drawing Production
BIM Manager	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N
BIM Coordinator	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N
BIM Modeler	N	N	N	N	N	N	N	N	N	Y	Y	Y

Source: BIMzeED project

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BIM Roles

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➢ **BIM Manager responsibilities**
- To define the BIM Uses and Objectives of the project.
- To create the project standards, define the workflows and reflect them in the BIM Execution Plan (BEP) according to the phase of the project.
- To create and manage the CDE.
- To establish audit and control processes to ensure compliance with customer BIM requirements.
- Technical support in the detection of interference or Clash Detection.
- To ensure interoperability and communication.

➢ **BIM Coordinator responsibilities**
- To assist the BIM Manager in drafting the BEP.
- To ensure compliance with the BEP or BIM Implementation Plan.
- To coordinate the work within his own discipline (or phase).
- To carry out the processes of checking the quality of the BIM model at a geometric and non-geometric level.
- To upload models in the CDE when appropriate.

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BIM Roles

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➢ **BIM modeler responsibilities**
- To model the project within your own discipline.
- To embed and extract information from the model in the specified formats. PDF, DWG, IFC, NWC
- To solve detected conflicts in clash detection reports.
- To read the BEP and model it according to your requirements.

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Other standards

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Standards that focus on defining standardised work processes and systems that are aligned with the basic principles of the BIM methodology centred on the organisation and management of information:

- COBie ⟶ specification aimed at owners or managers of assets (buildings) in which the basic information necessary for their correct maintenance is defined.

- ISO 19650 ⟶ Defines information management from different perspectives and the characteristics of the Common Data Environment.

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Pre-Construction BIM Project Management

Stage	Project Management BIM tasks	BIM applications
Briefing, Inception and Pre-construction	Feasibility analysis (technical and financial)	• BIM adoption question • Challenges to BIM adoption • Concept-stage BIM
	Value engineering	Options selection using BIM, Conceptual Estimating Modelling, Energy Analysis, Design Analysis
	Design management	BIM information exchange, 5D (rapid cost feedback to design changes), BIM Coordination
	Risk analysis and safety	Simulation, Virtual Reality (VR) and Augmented Reality (AR)
	Scheduling	4D Modelling
	Constructability analysis	4D Modelling, virtual mock-ups, VR and AR
	Procurement (design and construction)	BIM skills and capability mapping, BIM enabled Supply Chain Management, Constraint Analysis

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Pre-Construction BIM Project Management

The control during the pre-stage of the construction will help with quality checks and will ensure constructability by detection, modification and check of inconsistencies in the project.
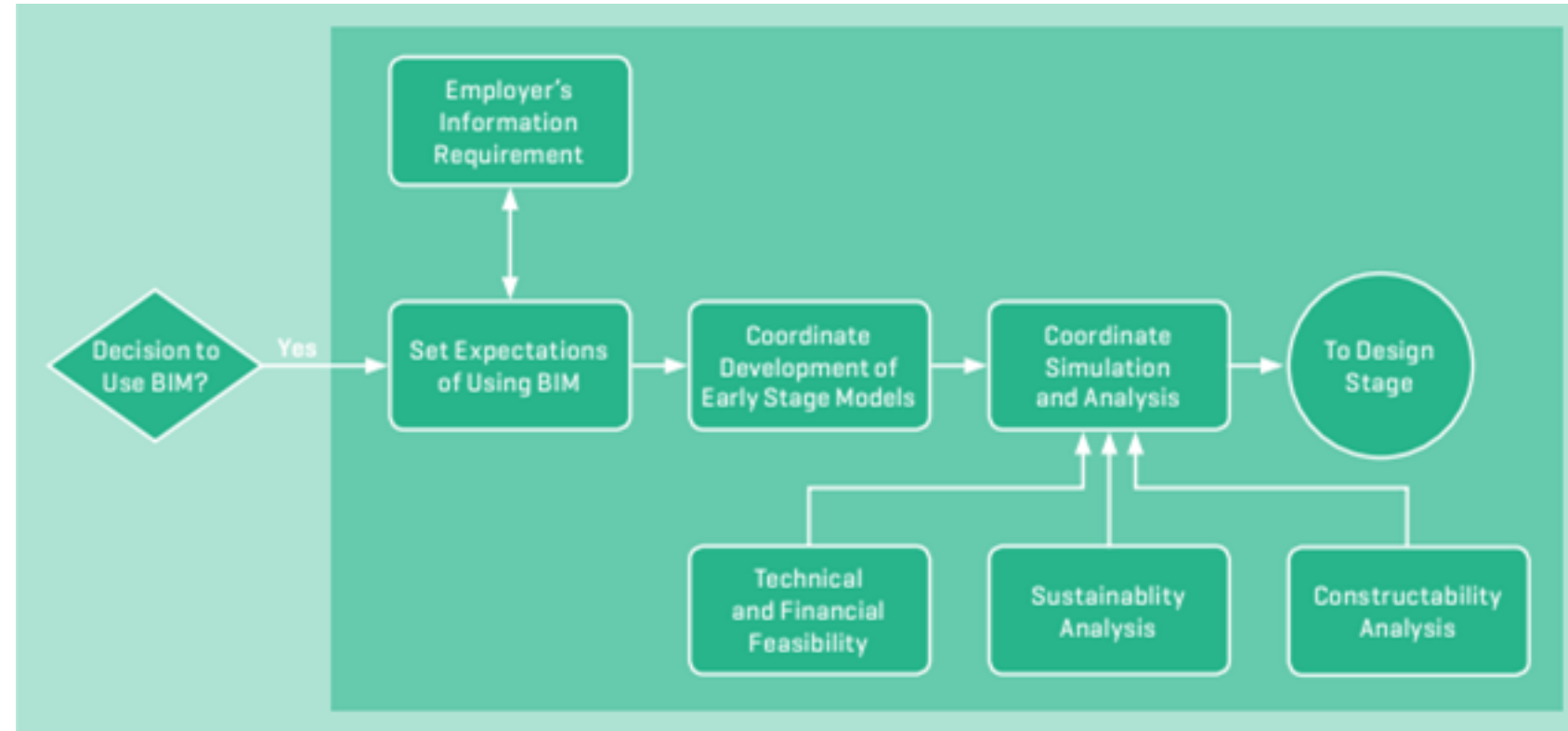
Construction BIM Project Management

Stage	Project Management BIM tasks	BIM applications
Construction	Phasing and prototyping	4D
	RFIs and issue resolution	BIM information exchange, BIM coordination
	Change management	BIM information exchange
	Monitoring and control	4D and 5D, Constraint Analysis, Progress Tracking and Production Planning

During the construction phase the following BIM project management activities take place:

- Ensuring model coordination
- Synchronisation of changes across models
- Monitoring EIR compliance
- Retaining overview and ownership of design during construction
- Maintain and developing the BEP

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Post-Construction BIM Project Management

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Stage	Project Management BIM tasks	BIM applications
Project closure	Contract and financial closure	Record model
	Project closure	Record model, Asset Information Model
	Handover	Record model, BIM for FM, Asset Information Management

BIM is the data repository where asset information is stored to be transferred to the owner's facilities management systems

In the post-construction phase the following BIM project management activities take place:
- Record as built model
- Asset Information Management
- Schedule of maintenance
- Building performance monitoring (as part of "Soft landings")

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Plan of Work

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A digital plan helps the project team understand their obligations and ensure appropriate deliverables of geometry, data and other documentation are prepared for the client to enable timely and efficient decision making throughout the life of the project.

Professional bodies have created complementary toolkits in the UK such as the RIBA Plan of Work and the NBS Digital Plan of Work
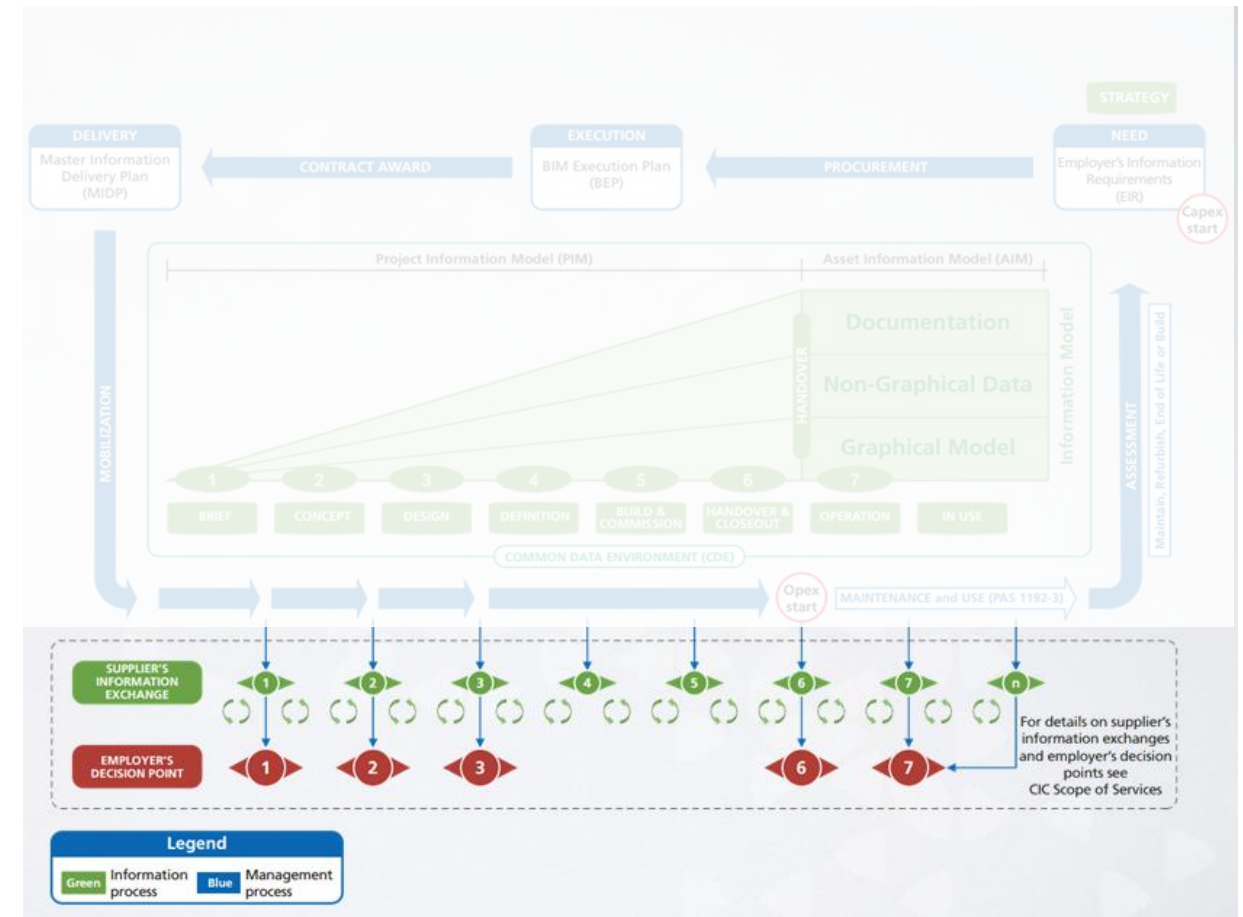
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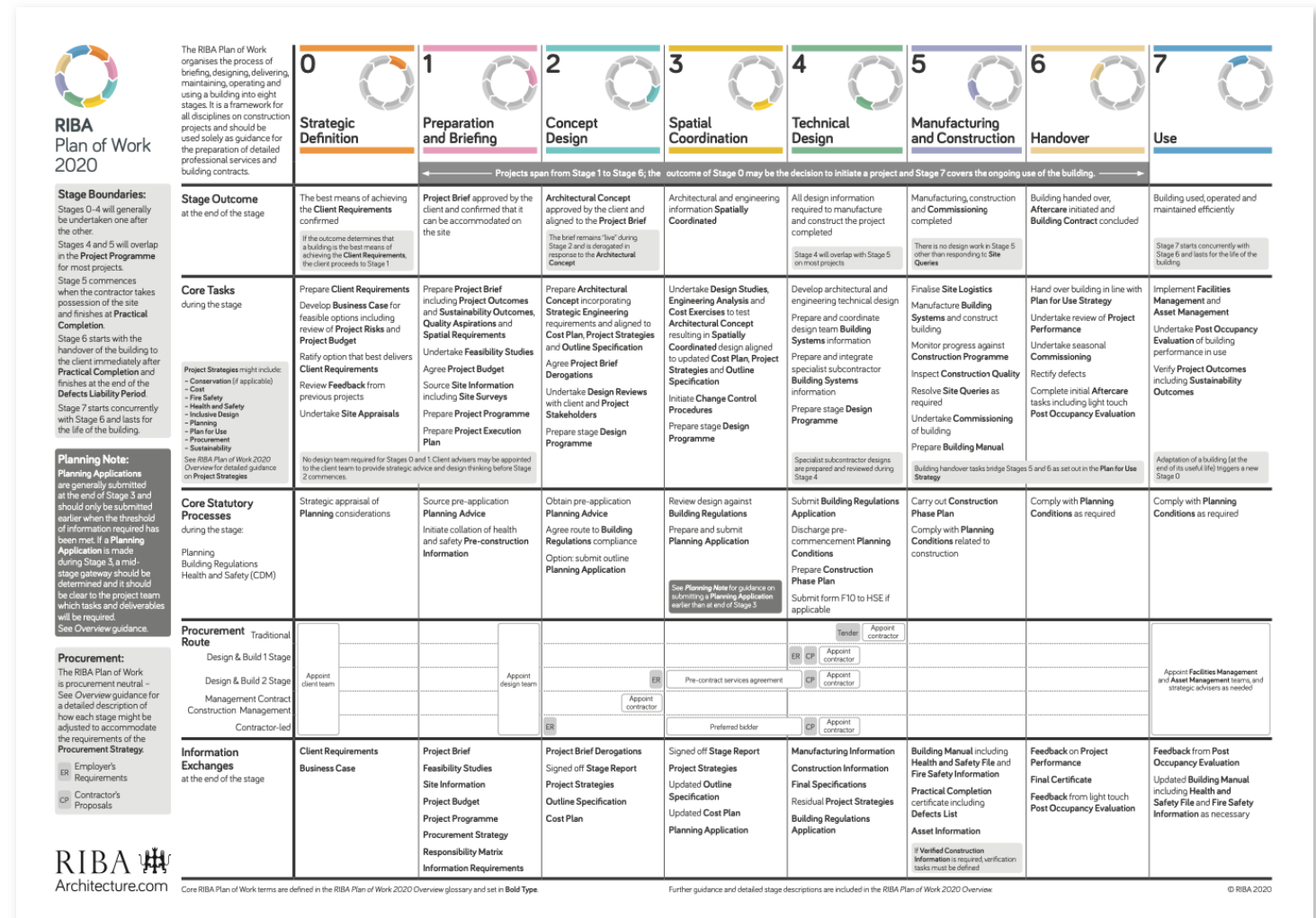
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Plan of Work - Example

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The RIBA Plan of Work provides a framework for the project team to approach design, construction and operational processes in the UK and worldwide.

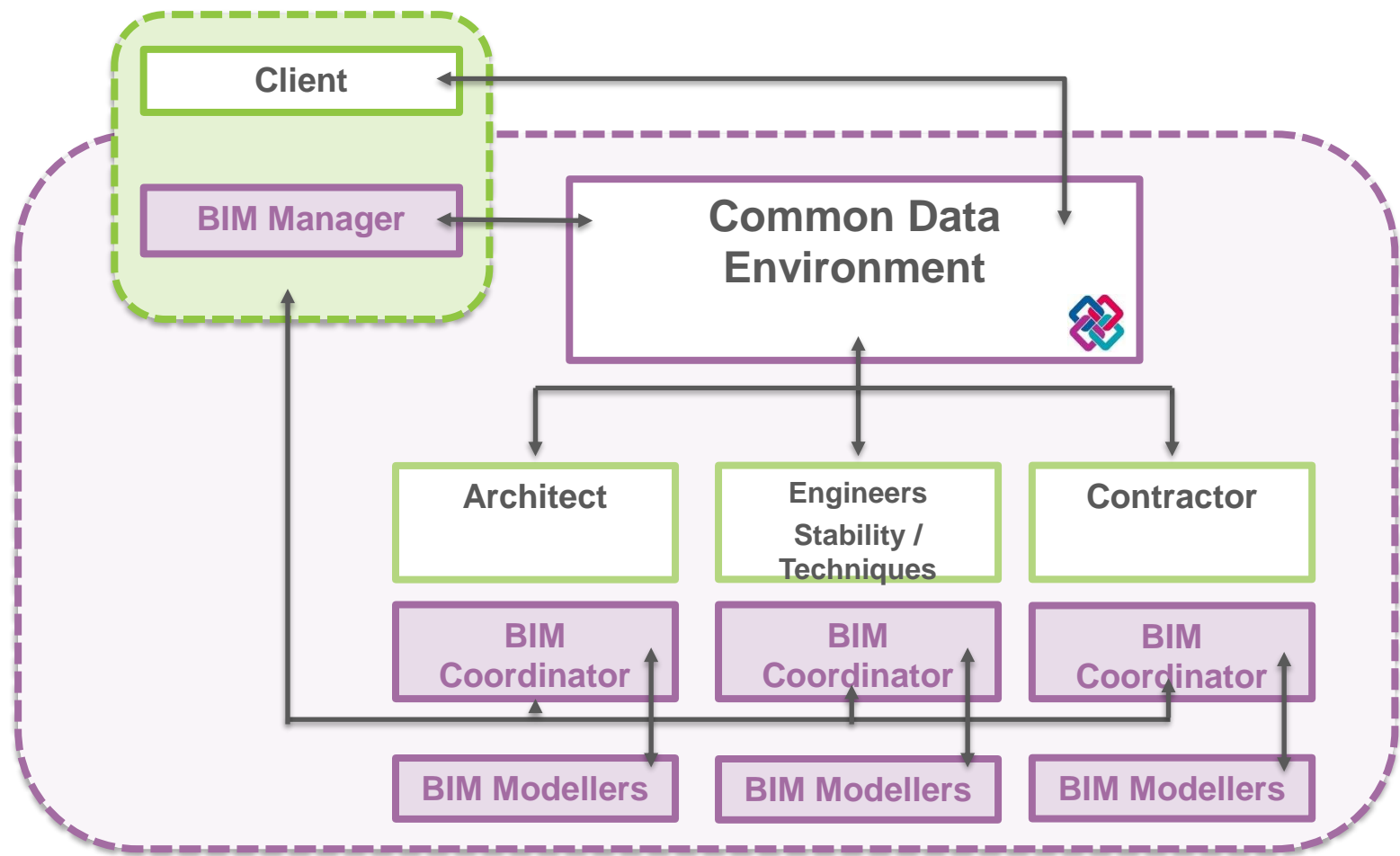Digitalisation in Construction:
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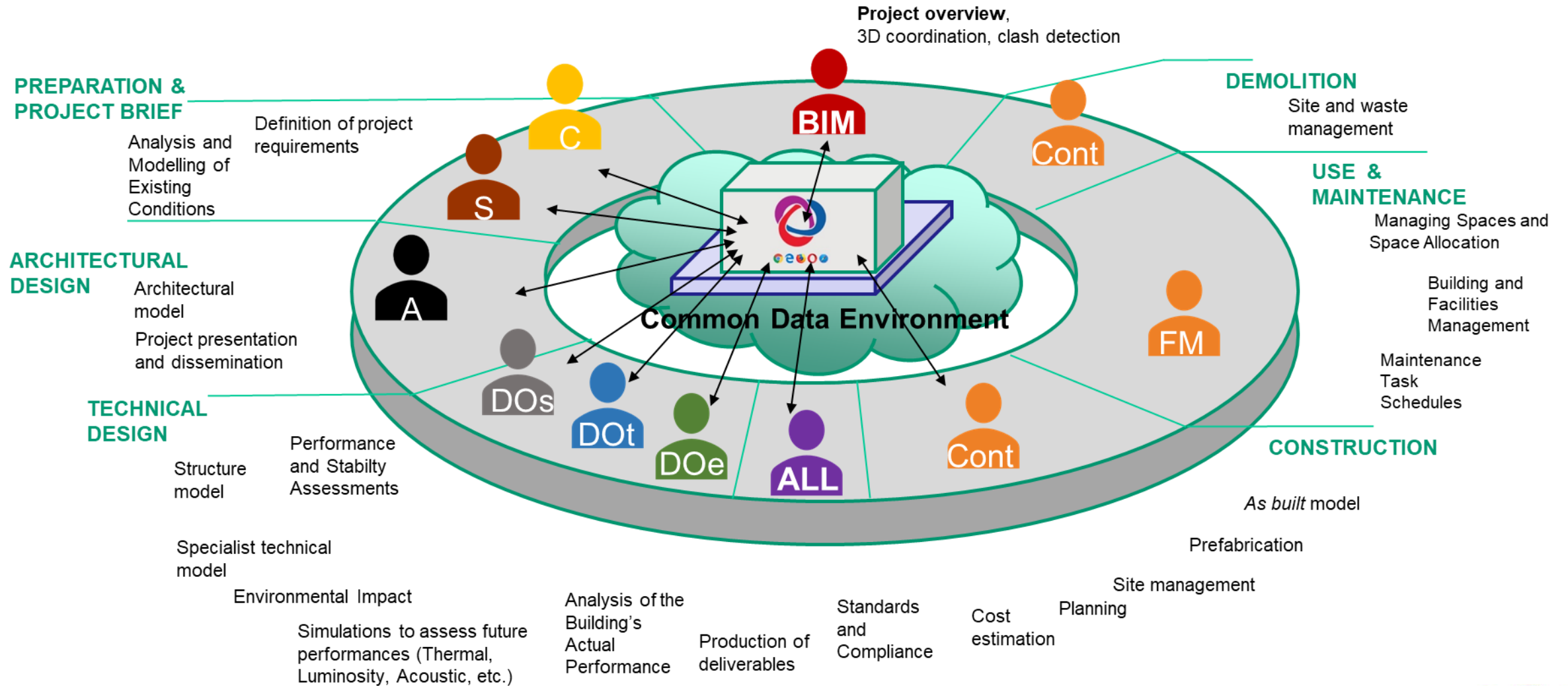Ollscoil Teicneolaíochta na Sionainne:
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Roles Summary

Client

BIM Manager

Common Data Environment

Architect

Engineers Stability / Techniques

Contractor

BIM Coordinator

BIM Coordinator

BIM Coordinator

BIM Modellers

BIM Modellers

BIM Modellers

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Information sharing - Summary

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QUIZ!

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