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Title: BIM Execution Plan (BEP)

1 – Aims

The objectives of this BIM Execution Plan (BEP) tutorial are as follows:

Learning about the BIM Execution Plan.

Knowing about several uses of BIM Execution Plan.

Efficiently organize the BIM Execution Plan in a project.

2 - Learning methodology

The teacher will give an explanation about BIM Execution Plan of about 30 minutes.

Students will read this tutorial and follow the steps shown in the tutorial, namely:

- BIM Execution Plan overview
- Project information
- Project BIM Goals and BIM Uses
- BIM process and strategy
- BIM exchange protocol and submittal format
- Project deliverables
- Electronic communications and BIM data requirement format
- Collaboration Procedures
- Model content requirements

In order to evaluate the success of the application, a questionnaire will be held for the students.

3 - Tutorial duration

The implementation described in this tutorial will be implemented through the BIMVET3 platform by self-learning.

2 lesson hours are suitable for this training.

4 – Necessary teaching recourses

Computer room with PCs with internet access.

Required software: Microsoft Office.

5 – Contents & tutorial

5.1 – Introduction

To efficiently organize the BIM implementation process on a project, a BIM Execution Plan (BEP) must be created before starting the design phase.

With the BEP, the following items are possible:

- Ability to summarize the overall vision of the project with implementation details for the project team to follow throughout the project;
- Ability to assist the employer and project members in documenting the agreed BIM deliverables and processes for the project and defining roles and responsibilities for each of these deliverables;
- Reducing the overall risk for all parties involved in the project by increasing the level of planning and reducing the number of uncertainties in the implementation process;
- Ability to articulate the scope of BIM implementation, process flow for BIM tasks, and information exchange between parties, as well as describe the necessary project and company infrastructure to support implementation.

5.2 - BIM Execution Plan overview

5.2.1. What is the BIM Execution Plan?

Building Information Modelling (BIM) is the process of creating and managing information about a construction project throughout its entire lifecycle. In other words, BIM is basically a different way of creating, using and sharing building lifecycle data.

BIM Execution Plan (BEP) is a plan that defines the objectives of implementing BIM technology in a project. Explains how to apply the created model, explains the application processes and ways of information exchange. It also contains information about all the project infrastructure necessary for a successful BIM implementation, namely the technologies we will implement, the team responsible for the implementation, and the contracts to be fulfilled.

It should be noted that there is no universal BIM application method for every project. Each team should effectively design a well-tailored BEP implementation strategy. Therefore, only the team that understands the project's goals, characteristics and capabilities of its members can effectively implement BIM in the project. After creating the plan, the team should monitor progress against the plan. Continuously developing, updating and correcting the plan at every stage of the project is crucial to obtain maximum benefit from BIM implementation.

5.2.2. Why is the BIM Execution Plan done?

One way to streamline the BIM implementation process on a project in an organized and efficient way is to create a BEP before starting the design phase. The BEP is a procedural process that outlines the overall vision of the project with implementation details for the project team to follow throughout the project. It also helps the employer and project members document the BIM deliverables and processes agreed for the project and defines roles and responsibilities for each of these deliverables. By increasing the level of planning, the number of uncertainties in the implementation process is reduced and thus the overall risk for all parties involved in the project is reduced.

5.2.3. BIM Execution Plan components

BEP should express the scope of BIM implementation, the process flow for BIM tasks and information exchange between parties, as well as describe the project and company infrastructure necessary to support implementation.

The steps to create an effective BIM Execution Plan are:

- Defining project information;
- Determining the project BIM targets;
- Choosing BIM uses;
- Creating a BIM process;
- Defining how to exchange information;
- Choosing the right infrastructure.

5.3 – Project information

This section contains information about the basic project data that should be considered such as: the name of the project, the owner of the project, the short project description (Table 1), project schedule (Table 2), BEP timeline (Table 3), Key project contacts (Table 4), BIM roles and responsibilities and BIM use staffing (Table 5).

Table 1: Basic Project Information.

PROJECT NAME	
PROJECT NUMBER	Contract number, task order, facilities project number, etc.
PROJECT OWNER	
PROJECT LOCATION	
CONTRACT TYPE	
PROJECT DESCRIPTION	
ESTIMATED PROJECT DURATION	

ADITIONAL PROJECT INFORMATION	Unique BIM project characteristics and requirements

(Source: Smithsonian Facilities BIM Guidelines (2021))

Table 2: Project schedule

PROJECT PHASE/ Milestone	START DATE	COMPLETION DATE	REVISED BIM PLAN	PROJECT STAKEHOLDERS INVOLVED
Preliminary planning	Date	Date	Yes/no	
Schematic design	Date	Date	Yes/no	
Design development	Date	Date	Yes/no	
Bidding documents	Date	Date	Yes/no	
Construction documents	Date	Date	Yes/no	
Project closeout	Date	Date	Yes/no	

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.3.1 BIM Execution Plan timeline

Table 3 illustrates an example of the timeline for implementation of BIM over the life cycle of the project. The table should be pre-filled with recommendations on which phase each activity will take place and should be adjusted to the specific project needs.

Table 3: BIM Execution Plan timeline

BIM Activity	Schematic Design	Design Development	Construction Documents	Construction	Facility Turnover
Creation			X		
BIM Kickoff Meeting	X			X	
Software standards and templates	X	X		X	
BIM Execution Plan updates	X	X	X	X	X
BIM collaboration meetings	X	X	X	X	X
Model progression table	X	X	X	X	
Exports		X	X		X
Facility Asset Data Spreadsheet	X	X	X	X	X
Record Model(s)			X	X	X

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.3.2 Key project contacts

In a BEP, a list of lead BIM contacts for each organization on the project team should be considered. Table 4 presents an example of a key project contacts.

Table 4: Key project contacts

Role	Organization	Contact Name	Location	E-Mail	Phone
Project manager(s)					
BIM manager(s)					
Discipline leads					
Other project roles					

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.3.3 BIM Roles and responsibilities

BIM Roles and responsibilities such as BIM Managers, project managers, drafts persons, among others should be described.

5.3.4 BIM Use staffing

For each BIM Use noted, it is important to identify the team within the organization (or organizations) who will staff and perform that Use, and estimate the personal time required (optional). Table 5 illustrate how this could be done.

Table 5: Example of BIM Use staffing documentation

BIM Use	Organization	Number of total staff for BIM Use	Estimated worker hours	Location(s)	Lead contact
3D coordination	Contractor A				
	Contractor B				
	Contractor C				
BIM creation	Architect				
	Civil Engineer				
	Structural Engineer				
	MEPF Engineer				

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.4– Project BIM Goals and BIM Uses

In this section, goals within the scope of BIM Project (Table 6) and BIM Uses are determined in line with these purposes (Table 7, and Table 8).

5.4.1 Major BIM Goals / Objectives

To create an effective BIM Execution Plan, it is very important to consider the benefits that BIM can bring to the project and define the goals we aim to achieve on this basis. To effectively define goals, such goals must be relevant to the project being created, as well as measurable and achievable for the project team.

The project team should document BIM goals for each project phase in order to assist in filling the table in Section 5.4.2. Examples are provided in grey below. These should be edited/replaced with project specific information.

Table 6: Example of BIM Goals documentation.

Project Phase	PRIORITY (1-3) 1- most important	GOAL DESCRIPTION	POTENTIAL BIM USES
Schematic design		Location, solar, wind, preliminary energy analyses	Efficient design decision making
Design		Address conflicts in design	3D Design coordination
Construction		Identify concerns with construction sequences	4D modelling
Turnover		As-built model	Turnover to model

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.4.2 BIM Uses

Table 7 and 8 presents an example of BIM uses that could be implemented on a project by placing a mark next to the BIM Use item (Reference the BIM Goals identified previously in the Section 5.4.1). Any additional uses could be insert in the empty cells of the table below, as applicable.

Table 7: Example of BIM Uses to be implemented on a project.

X	Plan	X	Design	X	Construct	X	Operate
x	Programming	x	Design authoring	x	Site utilization planning		Building maintenance scheduling
x	Site analysis (3D field positioning)	x	Design reviews / Model reviews	x	Construction system design		Building system analysis
	3D safety and logistics planning	x	Asset management	x	Asset management	x	Asset management

X	Plan	X	Design	X	Construct	X	Operate
		x	3D coordination / clash detection	x	3D coordination / Clash detection	x	Space management / Tracking
		x	Structural analysis	x	Digital fabrication		Disaster planning
			Lighting analysis		3D control and planning		Record modelling
			Energy analysis	x	Record modelling		
			Mechanical analysis				
			Other Eng. analysis				
			Sustainability (LEED) evaluation				
			Code validation				
	Phase planning (4D modelling)		Phase planning (4D modelling)	x	Phase planning (4D modelling)		Phase planning (4D modelling)
	5D cost estimation		5D cost estimation	x	5D cost estimation		5D cost estimation
	Existing conditions modelling	x	Existing conditions modelling		Existing conditions modelling		Existing conditions modelling
Legend: X = *Confirmed use*; O = *Potential use*							

(Source: Smithsonian Facilities BIM Guidelines (2021))

Table 8: Example of BIM uses and details.

Maturity	BIM Uses	Pre-design	Schematic design	Design development	Construction documents	Fabrication / Construction	Closeout	Operation & Management
Visualization	Programming							
	Site analysis							
	Design reviews							
	Phase planning (for presentations)							
Documentation	Existing conditions modelling							
	Design authoring							
	Cost estimation (Quantity take-off)							
	Record modelling							
	BIM requirements for FM							
Model-Based analysis	Space management and tracking							
	Engineering analysis							
	a. Energy analysis							

	b. Structural analysis							
	c. Lighting analysis							
	d. Mechanical analysis							
	e. Other Engineering analysis							
	Sustainability (LEED) evaluation							
	Disaster planning							
	Cost estimation (Estimating)							
	Phase planning (4D modelling)							
	Site utilization planning							
Integrated analyses	3D Coordination							
	Construction system design							
	3D Control and planning (Digital layout)							
	Digital fabrication (Supply chain management)							
	Building (Preventative) maintenance scheduling							
	Building system analysis							
	Asset management							
Automation & Optimization	Code validation							
	Digital fabrication (Off-site fabrication)							

5.4.3 Organizational Roles / Staffing

Figure 1 shows the individual disciplines. The circle in the middle shows the synthesis of multidisciplinary integration. This section presents an example of the roles and responsibilities of team members.

BIM Uses that are specific to the project should be noted in a table, including ranking values - High (Mandatory), Medium (Significant), Low (Minimal). An example is shown in Table 9.

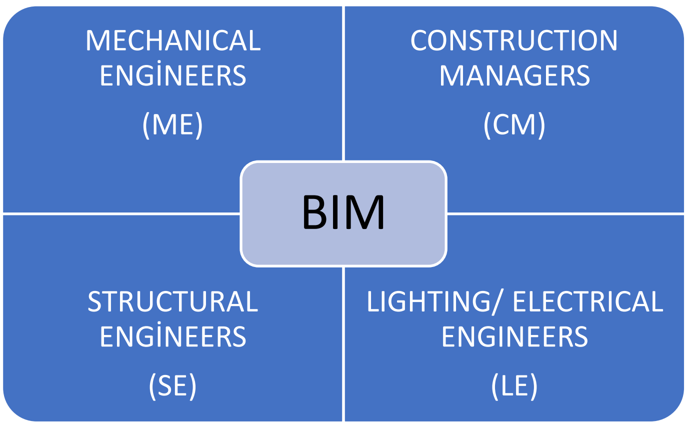


Figure 1: Multidisciplinary integration the individual disciplines

Table 9: Example of BIM Uses that are specific to the project and responsible party.

BIM Use	Value to project	Responsible party	Value to resp. party	Additional resources/ Skills req'd to implement	Notes	Proceed with use
	High/ Med/ Low		**High/ Med/ Low**			**Yes/No/ Maybe**
Record modelling	HIGH	Contractor	MED	Req. training and software		**YES**
		Facility Manager	HIGH	Req. training and software		
		Designer	MED			
Cost estimation	MED	Contractor	HIGH			**NO**
4D Modelling	HIGH	Contractor	HIGH	Need training on latest software	High value to owner due to phasing issues	**YES**
				Infrastructure needs	Use for Phasing & Construction	
3D Coordination (Construction)	HIGH	Contractor	HIGH			**YES**
		Sub-contractors	HIGH	Conversion to Digital Fab. Required	Modelling learning curve possible	
		Designer	MED			
Engineering Analysis	HIGH	MEP Engineer	HIGH			**MAYBE**
		Architect	MED			
Design Reviews	MED	Architect	LOW	Federated model views in the native design model	Reviews from design model no additional detail req.	**YES**
3D Coordination (Design)	HIGH	Architect	HIGH	Coordination software req.	Contractor to facilitate coordination	**YES**
		MEP Engineer	MED			

BIM Use	Value to project	Responsible party	Value to resp. party	Additional resources/ Skills req'd to implement	Notes	Proceed with use
	High/ Med/ Low		**High/ Med/ Low**			**Yes/No/ Maybe**
		Structural Engineer	HIGH			
Design Authoring	HIGH	Architect	HIGH			**YES**
		MEP Engineer	MED			
		Structural Engineer	HIGH			
		Civil Engineer	LOW	Large learning curve	Civil not required	
Programming	MED				Planning phase Complete	**NO**
Code Evaluation	LOW	Contractor	MED	Software req.	Streamline code review	**NO**
		Architect	LOW	Software req.		

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.5 BIM Process and strategy

Process mapping is a technique used to visually map workflows and processes. It involves creating a process map, also called a flowchart, process flowchart or workflow chart. The purpose of process mapping (e.g., Team Process Overview Map and Detailed Team Member Process Map) is to convey concisely and clearly how a process works.

Prepared process maps allow:

- visually communicate the steps needed to execute an idea, allowing to consolidate ideas and streamline processes.
- provides documentation of the process.
- enables faster decision making thanks to faster communication.

Figure 2 exemplify a Process Map.

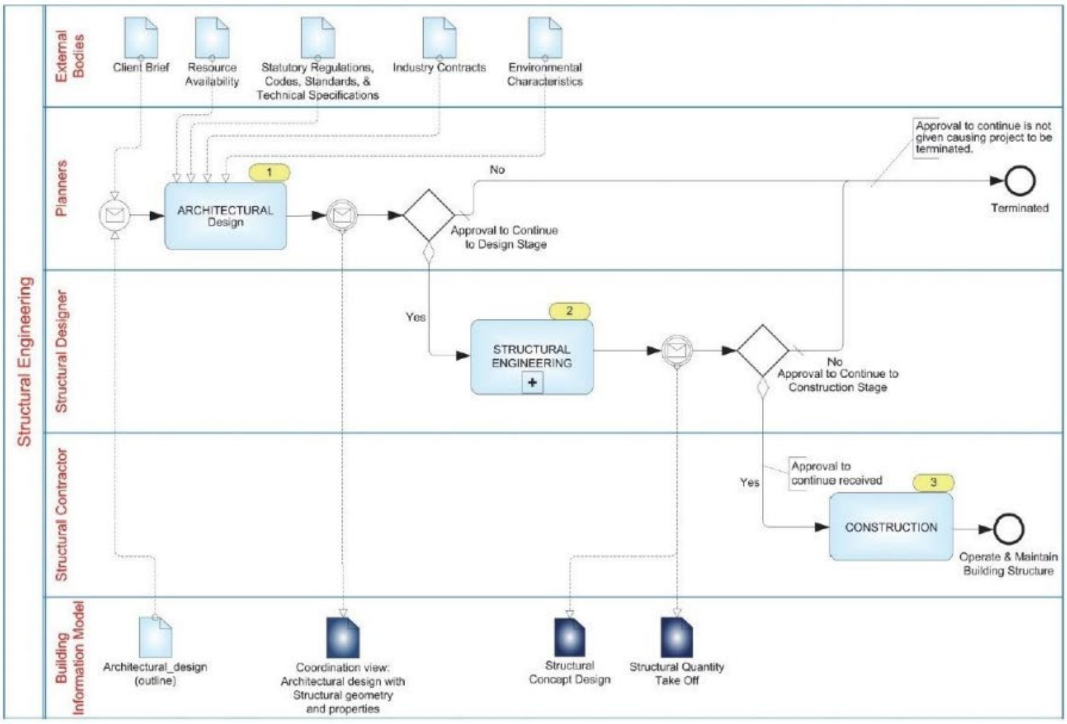


Figure 2 – Structural engineering business processes map (source: ATC-75 2010)

5.6 BIM Exchange protocol and submittal format

This section illustrates each of the team's uses of BIM and its result (Table 10). With the Team Overall Process Map, the duration of each BIM use is summarized according to the stages (Table 11). In addition, the files to be delivered are determined in which format (pdf, dwg, etc.) the 2D layouts will be presented, as well as the original program formats in which the data were prepared.

Table 10: BIM Goal use analysis.

BIM Goal use analysis worksheet				
BIM Use	Project importance (1-2-3)	Disciplines involved	Disciplines importance (1-2-3)	Necessary data
Design Phases				

Table 11: Team overall process map.

Team overall process map					
Presentation 1 …/…/2022	Presentation 2 …/…/2022	Presentation 3 …/…/2022	…….. …/…/2022	…….. …/…/2022	Final presentation …/…/2022

5.7 Project deliverables

At each phase of the Design and Construction process, the delivery of the model could be required, along with electronic versions of hardcopy submissions and other files that support the intent of the project.

Table 12 and 13 present an example of file types for Design and Construction deliverables.

Table 12: Example of design deliverables.

Phase	Submission requirements	Format
Programming	Narrative Project Execution Plan Existing Condition Model(s) Facility Asset Data Spreadsheet	.pdf .pdf, .docx .rvt, .dwg, .ifc, point cloud formats .rcs/.rcp/.pcg/.pts/.ptx/.dp/.las, .laz,.xyz, etc. .xlsx
Schematic Design (35% Submission)	Narrative Project Execution Plan Drawings Design Intent Model(s) Facility Asset Data Spreadsheet	.pdf .pdf .pdf .rvt, .ifc, .nwc, .nwd, .dwg .xlsx
Design Development (65% Submission)	Project Execution Plan LOD Matrix Specifications Drawings Design Intent Model(s) GIS Exports Facility Asset Data Spreadsheet	.pdf, .docx .pdf .pdf, .docx .pdf .rvt, .ifc, .nwd, .nwd, .dwg .dwg, .xlsx .xlsx
Construction Documents (100% Submission)	Project Execution Plan LOD Matrix	.pdf, .docx .pdf

Phase	Submission requirements	Format
	Drawings Specifications Design Intent Model(s) GIS Exports Facility Asset Data Spreadsheet	.pdf, .dwg .pdf, .docx .rvt, .ifc, .nwc, .nwd, .dwg .dwg, xlsx .xlsx
100% Construction Documents (Back Check Submission)	Project Execution Plan LOD Matrix Drawings Specifications Design Intent Model(s) GIS Exports Facility Asset Data Spreadsheet	.pdf, .docx .pdf, .xlsx .pdf, .dwg .pdf, .docx .rvt, .ifc, .nwc, .nwd, .dwg .dwg, xlsx .xlxs
Bid Process	Addenda	.pdf, .rvt, .dwg, .ifc
Construction	Bulletins	.pdf, .rvt, .ifc, .nwc, .nwd, .dwg
Record Documents	Project Execution Plan LOD Matrix Specifications Conformed Model(s) GIS Exports Drawings	.pdf, .docx .pdf, .xlsx .pdf, .docx .rvt, .ifc, nwc, .nwd, .dwg .dwg, .xlsx .pdf, .dwg

(Source: Smithsonian Facilities BIM Guidelines (2021))

Table 13: Example of construction deliverables.

Phase	Submission Requirements	Format
Construction (Monthly)	Coordination Model(s) Facility Asset Data Spreadsheet	.rvt, .ifc,. nwc, .nwd, .dwg .xlsx
Construction (Quarterly)	Construction Model(s) Facility Asset Data Spreadsheet	.rvt, .ifc, .nwc, .nwd, .dwg .xlsx
At project completion	As-Built Model(s) – Final Project Execution Plan LOD Matrix O&M and Warranty Documents GIS Exports Facility Asset Data Spreadsheet	.rvt, .dwg, .ifc, .nwc, .nwd .pdf, .docs .pdf, .xlsx .pdf, .docx .dwg, .xlsx

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.8 Electronic communications and BIM Data requirement format

5.8.1 BIM Data requirement format

All project documents (2D drawings, quantity studies, etc.) to be prepared within the scope of BIM processes must be produced in accordance with the Common Data

Environment (Project Management System). This Data Environment is a common database for all project information and documents. It allows sharing of projects and technical documents and controlling their revisions, tracking all correspondence on a common system and sharing data.

5.8.2 Technology infrastructure & Software

In this phase it should be determined the provision of a cloud system or main server, the installation of the infrastructure that provides instant access to all projects, the installation of the infrastructure and the hardware features of the system.

In addition, the software and format to be used for the models created between the stakeholders resulting from the revisions made during the project are determined at the beginning of the work. When updating is required, it should also be specified for which software, how and under whose responsibility (Designer/Manufacturer) it will be updated.

5.8.3 Software requirements

Table 14 illustrate an example of how detailed software applications employed could be done.

Table 14: Example of BIM detailed software applications

BIM Use	Discipline	Software	Version
Architecture Design	Architecture	AutoCAD and Revit	
Structure Design	Structure	AutoCAD (Add-on) and Revit	
HVAC Design	HVAC	Revit / AutoCAD (Add-on) CADduct and CADmech	
Plumbing Design	Plumbing	Revit / AutoCAD (Add-on) CADduct and CADmech	
Electrical Design	Electrical	Revit / AutoCAD (Add-on) CADelec	
Civil Design	Civil	AutoCAD Civil 3D	
Fire Protection Design	Fire Protection	MEP CAD AutoSprink	
HVAC Fabrication	HVAC	Revit MEP / AutoCAD (Add-on) CADduct and CADmech	
Plumbing Fabrication	Plumbing	Revit / AutoCAD (Add-on) CADduct and CADmech	
Electrical Fabrication	Electrical	Revit / AutoCAD (Add-on) CADelec	
Fire Protection Fabrication	Fire Protection	MEP CAD AutoSprink	

BIM Use	Discipline	Software	Version
Structure Detailing	Structure	Revit / AutoCAD (Add-on)	
Coordination	CM Coordination	Navisworks Manage, Revizto	
Model Check	All disciplines (as detailed in the project scope of work)	Revit Model Review report, output to a PDF format (converted from *.html format)	
Design Review	All disciplines	Bluebeam, Revizto, I-Manage	

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.8.4 Electronic file storage

An electronic storage location (such an FTP site, Drop Box, etc.) used for the regular exchange of files should be identified. Table 15 illustrate how this could be done.

Table 15: Example of BIM electronic storage location

File location	File path /Directory	File type	Password protect	File maintainer	Updated
FTP site ftp://ftp.***.***/***	Root Project Folder /Arch /Mech	.rvt	Yes ********	Name of the person	Weekly

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.8.5 Project folder structure

A folder structure definition will facilitate the delivery of federated project files while maintaining links to external files (the linked files must also be defined within the model).

The use of relative paths for links ensures that when those files are moved together to a new directory, links will be maintained (Figure 3).

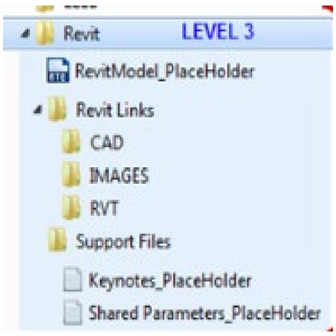


Figure 3: Example of a Project Folder Structure ((Source: Smithsonian Facilities BIM Guidelines (2021))

5.8.6 Information exchange schedule

The standard information exchanges and file transfers that will occur during the Project should be described. Table 16 illustrate what could be considered: Project files that will be transferred at regular intervals and identification of the locations (Electronic File Storage). Information about the Files that will be transferred according to the frequency listed by the project BIM team's, individuals responsible for coordination and data exchange (often identified as Discipline Model Managers or Trade Model Managers). Additional uploads may be also required as requested by CM BIM Manager.

Table 16: Example of information exchanges and file transfers

Information exchange	File sender	File receiver	One-Time or frequency	Due date or start date
Authoring – 3D Coordination	Architectural / Structural	FTP Post – Coordination Lead	Weekly	[Date]
As-built model updating check	Contractor		Monthly	

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.9 Collaboration procedures

A collaboration strategy should be defined, considering the following items:

- Weekly meeting schedule – time;
- Team communication – Google Docs, common file storage;
- Continual interdisciplinary interaction for building systems' integration;
- Team leaders selected based on project phase;
- Meeting minutes issued and discussed after each meeting to accomplish team objectives by next meeting date.

5.9.1 Meetings

a) Project meetings

Table 17 illustrate how to define the type of meetings held during the project, including coordination meetings, owner updates, progress meetings, etc. It also indicate the required attendees and the scope of the meeting.

Table 17: Project meetings

Meeting Type	Phase		Frequency	Participants	Location

(Source: Smithsonian Facilities BIM Guidelines (2021))

b) BIM Coordination meetings

Table 18 illustrate how to document the type and frequency of meetings related to BIM Coordination. It also indicate the required attendees and scope of the meetings.

Table 18: BIM Coordination meetings

Meeting Type	Phase	Frequency	Participants	Location

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.9.2 Coordination schedules

Examples to how outline the deliverables required and the anticipated date for completion.

Design

Deliverable	**Date**

Construction

Deliverable	**Date**

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.9.3 BIM Coordination

a) Model element color code

Before starting the Project, a color scheme could be defined to distinguish systems. Table 19 shows an example of a color code system.

Table 19: Example of a BIM model elements color code

System	Color	RGB Color Index
Outside Air (Pressurization)		128,255,255
Supply Air		0,128,192
Return Air		0,64,128
Exhaust Air		128,0,128
Mechanical Equipment		220,220,220
Mechanical Piping (Wet)		224,196,95
Mechanical Piping (Dry) Vent		255,128,64
Kitchen Exhaust		255,128,128
Plumbing Equipment		118,146,60
Plumbing (Domestic)		0,128,0
Plumbing (Sanitary Storm)		200,140,255
Plumbing (Sanitary Waste)		64,0,128
Lighting		254,159,106
Electrical		255,255,0
Telecommunications		128,128,64
Fire Protection		255,0,0
Fuel Supply		0,0,0
Irrigation		182,205,189
Structural		146,205,220

(Source: Smithsonian Facilities BIM Guidelines (2021))

In relation to the Integrated (Federated) Model/ Integration Processing accordance with the Project Schedule the Project BIM Manager usually will be responsible for performing clash detection with the design and/ or trade models. The clashes should be organized for review by the Project Team. Once clashes have been reviewed, a potential resolution will be assigned to a specific team member to be solved in a timely manner.

b) Hierarchy of systems coordination

If any system has interference or clash with a differing system, a discipline hierarchy for resolutions based on the consensus of the project team should be defined.

5.9.4 Quality control

The project owner is responsible for the quality of all models to be presented. The disciplines should check the model quality within themselves. The BIM manager is responsible for controlling the quality of the model, considering the coordination of all disciplines, within the framework of its defined responsibilities. In this section, checklists are created within the scope of the BEP and models are evaluated according to this list.

Table 20 presents an example of the checks that could be performed in the models to assure quality.

Table 20: BIM Checks

Check	Definition	Responsible party	Software program(s)	Frequency
Visual check	Ensure there are no unintended model components and the design intent has been followed	All model author(s)	Navisworks, Revit Other	Each milestone deliverable
Interference check	Detect programs in the model where any building components are clashing including hard and soft	All model author(s)	Navisworks, Revit other program(s) TBD	
Standards check	Ensure that the BIM standards have been followed	All model author(s)	Navisworks, Revit Other	Continuous
Model integrity checks	Describe the QC validation process used to ensure that the Project Facility Data set has no undefined, incorrectly defined, or duplicated elements and the reporting process on non-compliant elements and corrective action plans	All model author(s)	Navisworks, Revit Other	Weekly
Model Review / Model Checker	An automated global model review and report feature	All model author(s)	Revit Other	Each milestone deliverable

(Source: Smithsonian Facilities BIM Guidelines (2021))

In the model checking requirements the software to perform an automated model review of the Project should be defined. Additional rules may be added to the configuration files by the project BIM team for project-specific requirements.

In addition, models should include dimensioning as needed for design intent, analysis, and construction. Thus, the Level of Accuracy (LOA) of the model should also be defined.

The BIM team should perform an automated model review of project model using, for example, the *Revit Model Review* application (an add-in application available through the Autodesk subscription website) or by using Autodesk Model Checker (also an add-in application for Revit).

5.10 Model content requirements

In the BIM Implementation plan, mandatory information requirements are defined depending on the scope of the Project:

• Architectural Model Requirements: Doors, windows, elevators, escalators, screens, turnstiles, furniture, lighting elements, routing elements, MEP equipment, etc.

It is defined which information will be given for all building elements and all materials used;

- Structural Model Requirements: Reservations on vertical/horizontal circulation elements, all shafts, spaces, stairs, carrier elements are processed into the BIM model with their brief explanations;

- Mechanical Model Requirements: The width, height and height information of the elements of the systems are modelled as 3D parametric;

- Electrical and Electronic Model Requirements: All generators, transformers, cable trays, fixtures, switches, sockets, announcements, telephones, passenger information screens, card readers, detectors, etc.. Medium voltage, Direct voltage and Low voltage etc. The main equipment of all systems are shown in the model.

5.10.1 Model content LOD

This section describes some of the standards required for project deliverables along with *Modelling Level of Development* definitions.

A BIM Content LOD matrix should be developed by the project team. Table 21 illustrate a template of a BIM Content LOD matrix.

Table 21: Example of a template of a BIM Content LOD matrix

Project Stage			Design Model			Design Intent Model (to) Integration with SI		
BIM Use Title			Model Element (3D)	Model Element (2D)	Data Only (Specs)	Existing Conditions (to) As-Built & Record Model		O&M Criteria
Time of Exchange (SD, DD, CD, Construction)								
Responsible Party (Information Receiver)								
Receiver File Format								
Application & Version								
			Yes (Y) / No (N)			Level of Development (LOD) and Model Element Author (MEA)		
Model Element (ASTM Uniformat II) Classification			Y/N	Y/N	Y/N	LOD	MEA	
A	SUBSTRUCTURE							
	A10	Foundations						
	A20	Basement Construction						
B	SHELL							
	B10	Superstructure						
	B20	Exterior Enclosure						
	B30	Roofing						
C	INTERIORS							
	C10	Interior Construction						
	C20	Stairs						
	C30	Interior Finishes						
D	SERVICES							
	D10	Conveying						
	D20	Plumbing						
	D30	HVAC						
	D40	Fire Protection						
	D50	Electrical						
E	EQUIPMENT AND FURNISHINGS							
	E10	Equipment						
	E20	Furnishings						
F	SPECIAL CONSTRUCATION AND DEMOLITION							
	F10	Special Construction						
	F20	Selective Bldg Demo						
G	SITEWORK							
	G10	Site Preparation						
	G20	Site Improvements						
	G30	Site Civil/Mech Utilities						
	G40	Site Electrical Utilities						
	G50	Other Site Construction						
*	Additional Information							
	1	Construction Systems						
	2	Space						
	3	Information						
	4	Datum						
		Additional						
ALL EXISTING CONDITIONS TO BE MODELED TO A 200 LEVEL UNLESS DIRECTLY AFFECTED BY NEW CONSTRUCTION. THEN MODELED/DETAILED TO A 300 LEVEL TO ALLOW FOR DEMOLITION DRAWINGS AND TIE IN INFORMATION								

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.10.2 Worksets

Worksets is a way to separate a set of elements in the project model into subsets for "worksharing". During project BIM development, users should be aware of the active workset. There may be one or many worksets in a project. Each new model element added to the project will be placed in the active workset. Table 22 and 23 presents an example of the essential worksets in a work shared project for architectural models.

Table 22: Example of workshets for large projects where disciplines are modelled in separate Revit models.

Workset name	Purpose
Exterior shell	Include all exterior shell elements of the building(s)
Interior	Include all interior elements of the building(s) except furniture and equipment
Core	Include core structure and core elements of the building(s)
Furniture	Include all interior furniture and equipment elements of the building(s)
Exhibits walls	Include exhibit walls/partitions different from interior walls and exhibits
Exhibits	Include exhibits
Grid and levels	Include grids and levels
Links	Include linked discipline models
Architectural lighting	Include light locations as per the architect so that they can be turned off or removed easily when lighting from MEP is finalized
Signage	Include interior and exterior signs
Security/Surveillance and access	Include locations for CCTVs, motion detectors, screening devices, push button mounts, etc.

(Source: Smithsonian Facilities BIM Guidelines (2021))

Table 23: Example of worksheets for small projects where disciplines are included within the Architectural Revit model.

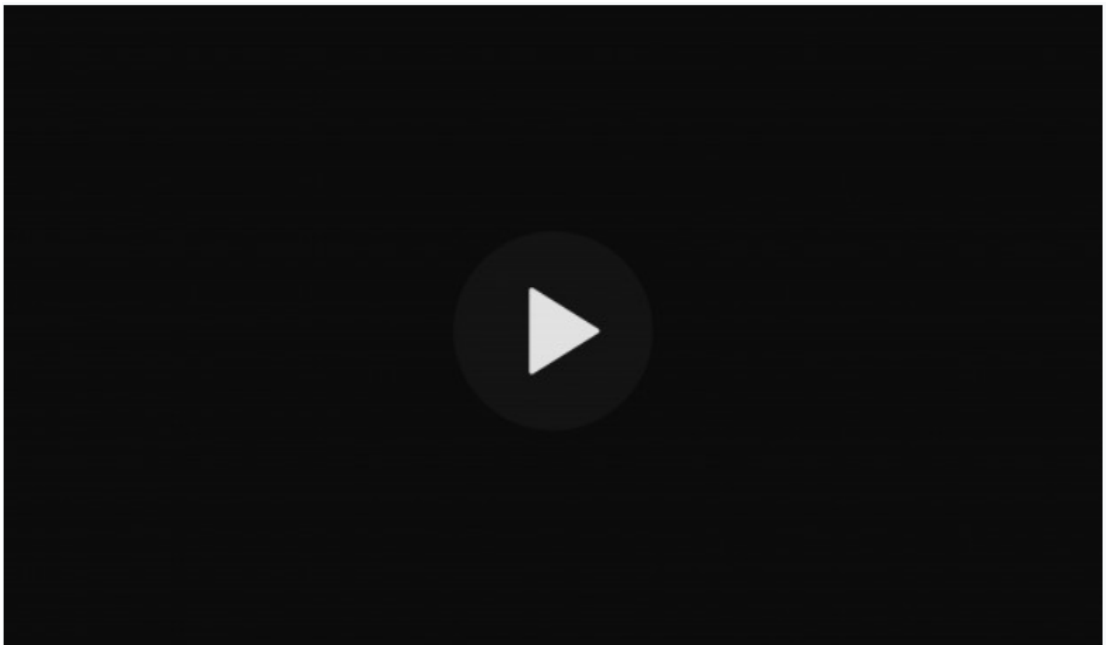
Workset name	Purpose
Exterior shell	Include all exterior shell elements of the building(s)
Interior	Include all interior elements of the building(s) except furniture and equipment
Core	Include core structure and core elements of the building(s)
Furniture	Include all interior furniture and equipment elements of the building(s)
Exhibits walls	Include exhibit walls/partitions different from interior walls and exhibits
Exhibits	Include exhibits
Grid and levels	Include grids and levels
Separate discipline worksets	Include separate discipline worksets for Mechanical, Electrical, Plumbing, Fire Protection, Structural and Life Safety
Signage	Include interior and exterior signs
Security/Surveillance and access	Include locations for CCTVs, motion detectors, screening devices, push button mounts, etc.

(Source: Smithsonian Facilities BIM Guidelines (2021))

5.11 - Slide

This tutorial will show a PowerPoint presentation with examples on how to prepare a BIM Execution Plan.

.pptx



References

Autodesk Model Performance Technical Note White Paper http://images.autodesk.com/adsk/files/autodesk_revit_2014_model_performance_technical_note.pdf

Penn State Computer Integrated Construction http://bim.psu.edu/

Bim project execution plan version 1.05 created from the buildingSMART alliance™ (bSa) Project "BIM Project Execution Planning" as developed by The Computer Integrated Construction (CIC) Research Group of The Pennsylvania State University

https://cdn.ymaws.com/www.nysapls.org/resource/resmgr/2019_conference/handouts/hale-g_bim__05a_bim_pxp_temp.pdf

Smithsonian Facilities BIM Guidelines (2021)

https://www.wbdg.org/ffc/si/smithsonian-criteria/smithsonian-facilities-bim-guidelines

6 - Deliverables

To evaluate the success of the application, students will have to answer an online questionnaire.

Co-funded by the Erasmus+ Programme of the European Union

7- What we have learned

How to prepare a BIM Execution Plan.

Why is the BIM Execution Plan prepared.

What are the BIM Execution Plan components.