University of Chicago
BIM Standards

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Strategy & Objectives

1. General

1.1. Strategy & Objective

Efficient use of technology improves the delivery of capital projects and their on-going operation. The intent of this document is to specify the desired use of such a technology, known as Building Information Modeling (BIM), to realize specific project improvements. When properly followed, this document will enable project teams to successfully deliver expected project improvements and provide consistent results across the organization.

The following requirements will describe the necessary information for a general understanding of required BIM activities relative to content (what is required), format (how is it to be delivered), responsibility (who does what), schedule (timing for development), and process (specific actions needed).

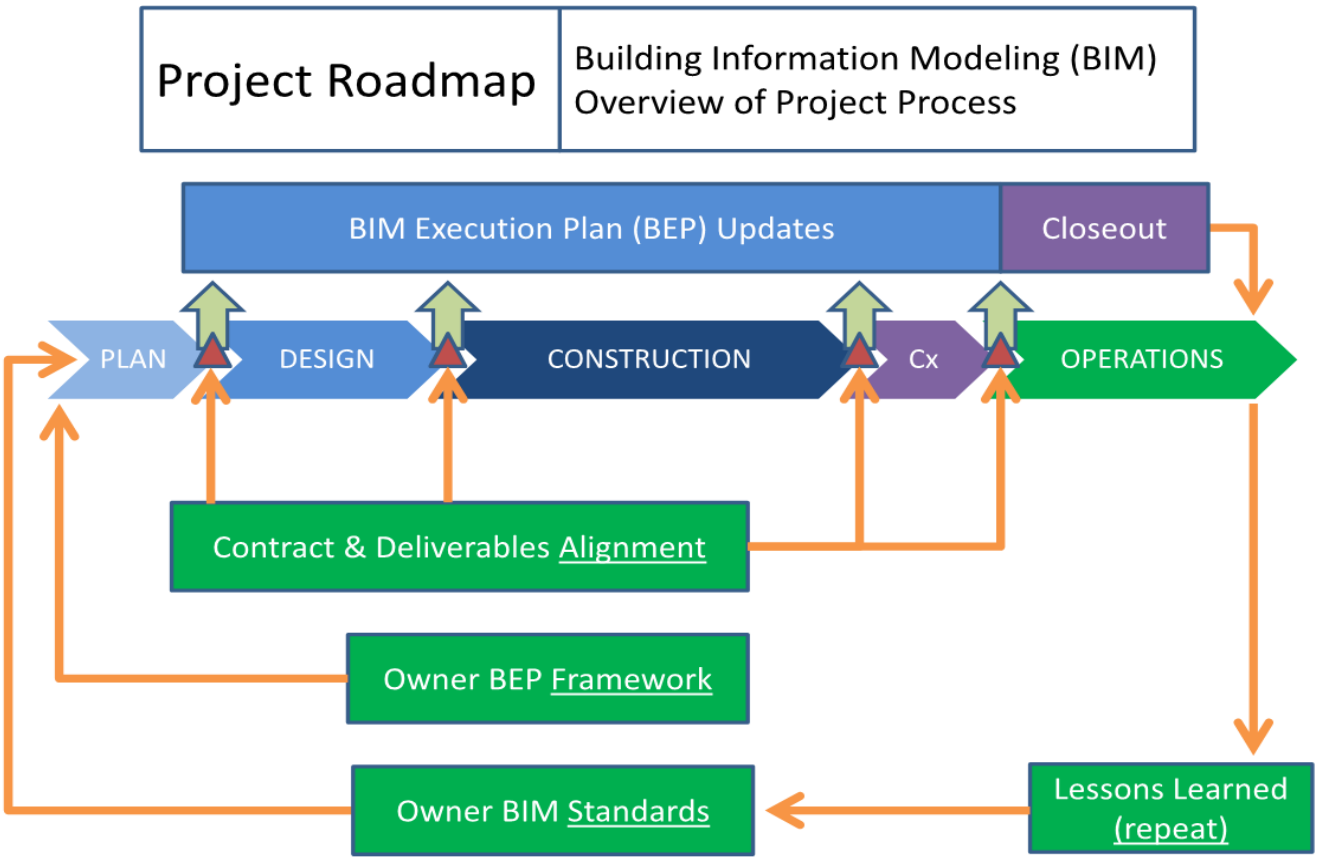
The specification uses both performance based criteria and prescriptive criteria requirements. Performance based criteria allows for project participants to develop their own plan for achieving a particular and described outcome. This allows team members to employ their own "means and methods" to achieve the described outcome without the owner being overly restrictive. Prescriptive criteria are used when absolutely necessary, in order to meet a specific requirement of an operational tool or process. The prescriptive elements are derived from and driven by the owner's operational platforms and systems. The platforms and systems are typically systems of record or legacy programs that require information and documents in a particular format.

The use of performance and prescriptive criteria is designed to afford as much flexibility in the requirements as possible. Additionally, this allows for collaboration among project teams to deliver products (deliverables) and services that benefit from being aligned with a project team's unique skills, methodologies, and schedules while meeting the overall intent of the requirements.

The term "BIM Use" is used in these standards. BIM Uses are simply "applications" of technology to different aspects of the design and construction market sector. The owner has conducted a comprehensive assessment of available and market-accepted BIM Uses. The owner's accepted BIM Uses are contained within these standards for reference in Section 3. As other owner BIM Uses are developed and approved, they will be incorporated into these standards during future revisions. There are many BIM Uses that are excluded from these standards but are under development and are being considered for addition in the future.

1.2. Road Map

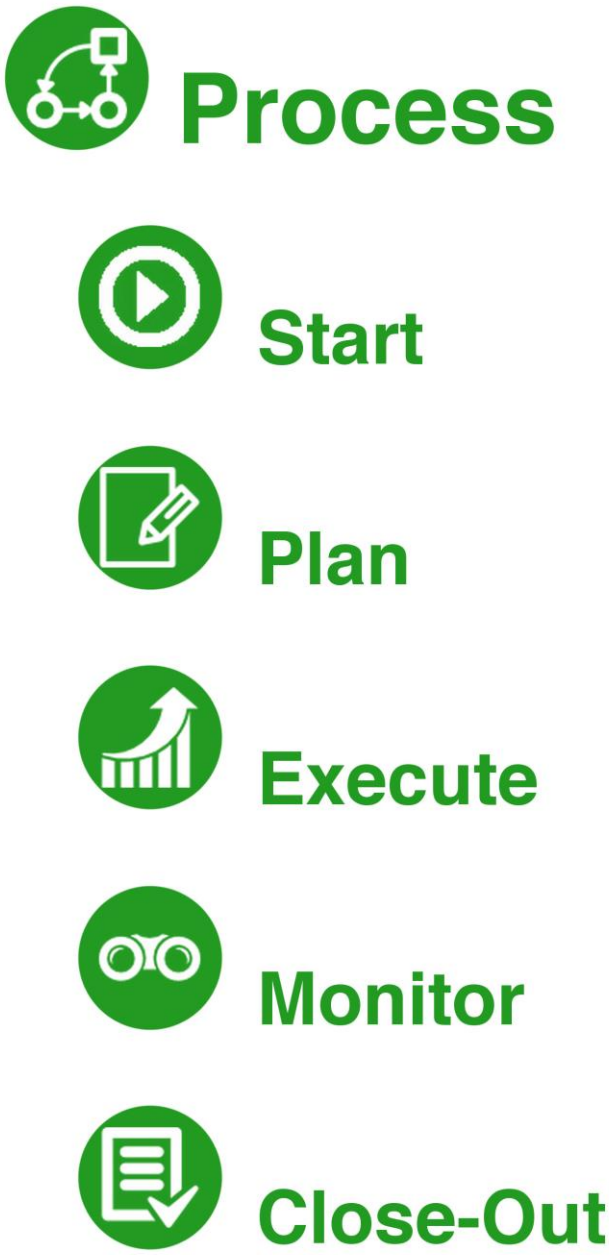
1.2.1.Project Roadmap



Process most directly reflects Design-Bid-Build, however, the process aligns similarly with other delivery models

1.2.2.Project Process Diagram

Process Groups / Roles	Start	Plan	Execute	Monitor	Close
Owner	chose BIM uses	set BIM Execution Plan (BEP) schedule	review and comment on updated BEP documentation	review for updates to BEP	test use / import of BIM uses for operational support and readiness
	align RFQ & RFP	outline required BIM uses		progress review BIM use and publish reviews with issue log	close out BIM use punch list
	help respondents understand BIM scope	outline BIM goals with team			draft acceptance note for BIM uses
	align contracts with BIM uses	outline support roles in BEP (Commissioning Agent, FS staff, etc.)			incorporate & store BIM uses in organization
		review and comment on BEP			draft lessons learned and incorporate into BIM standards
Design	respond to RFQ with BIM plan & qualifactions	begin drafting of BIM Execution Plan (BEP)	progress BIM uses	submit BIM use for review per BEP schedule	submit BIM use per schedule of BEP
		colloborate with team and document level of detail for BIM uses	update BEP with project progress and development	adjust BIM uses as necessary and in accordance with issues log from BIM use progress review	
Construction	respond to RFQ with BIM plan	begin drafting of BIM Execution Plan (BEP)	progress BIM uses	submit BIM use for review per BEP schedule	submit BIM use per schedule of BEP
		colloborate with team and document level of detail for BIM uses	update BEP with project progress and development	adjust BIM uses as necessary and in accordance with issues log from BIM use progress review	


Process
Start
Plan
Execute
Monitor
Close-Out

Start

2. Process

2.1. Start

Definition/Description: The start milestone is a short, but necessary, stage gate for any project leveraging BIM processes. In this stage, initial direction will be set for how BIM will be pursued on the project and aligned with the overall BIM program. This allows for appropriate planning and inclusion into Project Charters, Project Budgets, Requests for Qualifications (RFQ), Request for Proposals (RFP), Contracts, and multiple other project requirements, documents, and processes.

Note - RACI tables are used in these standards to communicate roles and assignments. See the Glossary for more explanation about the RACI model for project roles.

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Set direction & choose BIM Uses	BIM Manager	Project Manager	BIM committee	BIM committee
B	Align RFQ & RFP with BIM Uses	BIM Manager	Project Manager	BIM committee	BIM committee
C	Help respondents understand level of detail for BIM uses	BIM Manager	Project Manager	Respondents	BIM Committee, Respondents
D	Respond to RFQ & RFP and understand BIM Standards	Respondent	Respondent	BIM Manager	Owner, Project Manager
E	Align contracts with BIM Uses	BIM Manager	Project Manager	BIM committee	Project Manager, Architect, Contractor

Input

- BIM Standards
- Program of Requirements (POR) (if developed)
- Access to current RFQ & RFP templates (documents)
- Design, Construction, & Commissioning contracts
- Project Commissioning Approach (internal or external resource)

Output

- RFQ & RFP BIM language (clauses / references)
- BIM alignment with Design, Construction, & Commissioning contracts
- BIM-FM BIM Execution Plan (BEP) template for AEC team

Start

Tools

- BIM Use Determination Matrix - Appendix A

Template

- Sample language for RFQ - Appendix B
- Sample language for RFP - Appendix C
- Sample language for design contracts - Appendix D
- Sample language for construction contracts – Appendix E

Plan

2.2. Plan

Definition/Description: The Plan milestone relies on the direction set in the Start stage to produce an implementation plan. This stage aligns the planning documents set up by the Organization BIM Manager with the project participants means and methods, allowing AEC teams to outline an implementation plan that meets the project expectations of the Owner.

It is important to realize that multiple iterations of planning might be necessary to account for the project delivery method employed. For example, in a Design-Build scenario, the project team can begin working through one BIM Execution Plan (BEP) that can constantly improve throughout the project. However, in a Design-Bid-Build scenario, the Architect will need to initiate a BEP prior to the Contractor being selected, then the selected Contractor will need to integrate their efforts into the Architects' plan to create a revised project BEP. Lastly, in a CMAR scenario, the AE team will begin the BEP process in advance of the CMAR being selected. Once a CMAR is selected and providing pre-construction services, the CMAR can join the BEP process and incrementally add to the BEP. The CMAR's participation (during pre-construction) will aid in shaping the project budget (GMP), expectations for subcontractors, and related specifications.

BEP work shall begin within 30 calendar days of contract award for each respective entity (AE, CM, CxA, others) in order to generate early engagement and productive BIM deliverable developments.

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Begin BIM Execution Planning (BEP)	Architect, Contractor (Note 1)	Project Manager	BIM Manager, Owner	Project Team
B	Set BEP meeting schedule	BIM Manager	Project Manager	Architect, Contractor	Project Team
C	Document required BIM uses	BIM Manager	Project Manager	BIM Committee	Project Team
D	Document BIM goals and other non-required BIM uses	BIM Manager	Architect, Contractor, BIM Manager	Project Team	Project Team

ID	Task	Responsible	Accountable	Consulted	Informed
		(Note 2)			
E	Discuss and document appropriate level of detail per BIM use	Architect, Contractor (Note 1)	Project Manager	Project Team, BIM Manager	Project Team, BIM Committee
F	Document additional support roles (Commissioning, Facilities Staff)	BIM Manager (Note 2)	Project Manager	BIM Committee	Project Team
G	Review and Comment on BEP documentation	BIM Manager (Note 2)	Project Manager	Project Team	Project Team

Note 1 - Based upon the project delivery method employed, the Architect and Contractor become engaged on various schedules. Each entity shall author their own portion of the BEP at an appropriate and agreed upon time as related to the project delivery method used.

Note 2 (General Note) - The BIM Manager's overall role is to facilitate the BIM activities for the project team. This is done by steering, guiding, and advising the team and not specifically performing the BIM activities and detailed documentation of the team in the BEP. The BIM Manager supports the owner's project manager in the accomplishment of the BIM program specifically by supporting the team to be successful over the entire project duration and in the transition to operations.

Input

- Summary design schedule with document release milestones
- Summary construction schedule (milestones)
- Owner's Asset Classification Table - Appendix 3.C
- Owner's georeference model requirements - Appendix G

Output

- Project-specific BIM Execution Plan (BEP)
    - One integrated document
    - Sections are authored by specific team members
    - Owner items are also included (as needed)

Plan

Template

- See Appendix F for BIM Execution Plan (BEP) template

Example

- Design team project process map sample - Appendix H
- Construction team project process map sample - Appendix I

2.3. Execute

Definition/Description: This stage outlines the implementation activities of the project participants in performing the work related to BIM deliverables. Much of the implementation plan that is specific to the actual project will be outlined in the BIM Execution Plan (BEP) during the Planning stage, and thus limited information will be shown in this section.

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Progress BIM uses	Project Team	Architect, Contractor	BIM Manager	Project Manager, Owner, BIM Manager
B	Update BEP with project progress and development	Architect, Contractor (Note 1)	Project Manager (Note 2)	Project Team, BIM Manager	Project Team
C	Review and Comment on updated BEP documentation	BIM Manager	Project Manager	Project Team	Project Team

Note 1 - Based upon the project delivery method employed, the Architect and Contractor become engaged on various schedules. Each entity shall author their own portion of the BEP at an appropriate and agreed upon time as related to the project delivery method used.

Note 2 - The owner will make every effort to document the baseline BIM requirements for a given project as defined in these standards and in other contractual documents. The owner's intent is to reference these standards and provide other clarifications in project team agreements. However, it is conceivable that the owner's BIM expectations could change over time from the original intent and agreements. If so, then the project team members would be justified in requesting an equitable adjustment in accordance with the owner's change control procedures. It should be further understood that these standards do not outline every detail required but provide both prescriptive criteria (where details can be defined) and performance criteria (where outcomes are defined

Execute

but means and methods are subject to the project team member). Thus, some professional judgement is expected to be applied by the project team member on behalf of the owner within reason.

Input

- Project-specific BIM Execution Plan (BEP)

Output

- Project BIM use deliverables

2.4. Monitor

Definition/Description: This stage involves regularly scheduled reviews of BIM use deliverables (and associated processes) provided by the Design and Construction teams according to the BEP and BIM Standards. These maturing deliverables shall be reviewed and assessed by the BIM Manager for compliance with the owner's BIM standards, project-specific BIM Uses, and contractual requirements. The review will take into consideration the BIM deliverable's requirements (i.e., content, format, accuracy, and scheduled maturity). Each review will document comments and/or issues for resolution in a manner that is consistent with the project team's communication plan.

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Review for updates to BEP	BIM Manager	Project Manager	Project Team	Project Team
B	Submit BIM Use deliverables per schedule in BEP	Architect, Contractor	Architect, Contractor	BIM Manager	BIM Manager, Project Manager
C	Progress review BIM use and publish reviews with issue log	BIM Manager	BIM Manager	Project Team, Cx Agent (determined in BEP)	Architect, Contractor, Project Manager, Owner
D	Adjust BIM uses as necessary and in accordance with issues log from BIM use progress review	Project Team	Architect, Contractor	BIM Manager	BIM Manager, Project Manager
E	Test use / import of BIM uses for operational support and readiness	BIM Manager	BIM Manager	Project Team, BIM Committee	Owner, Project Team, BIM Committee

Monitor

Input

- BIM Use deliverables from responsible party (Architect, Contractor, or other)
- Project-specific BIM Execution Plan (BEP)
- Project records / correspondence / meetings

Tools

- Model checking and coordination software, such as NavisWorks by AutoDesk (or similar)
- Software that may be specific to a particular deliverable
- COBie compliancy software (if applicable for FM Data deliverables)

Output

- BIM Use issue log (or other project tracking means in use by owner)
- Updated Project BIM Execution Plan (BEP) (if adjusted)
- Reviews / Reports / etc for project manager, committee, etc

2.5. Close-out

Definition/Description: This stage involves the actions necessary for finalizing the BIM Use deliverables and handing them off for the owner's acceptance and use.

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Submit BIM use per schedule of BEP	Architect, Contractor	Architect, Contractor	BIM Manager	BIM Manager, Project Manager, Owner
B	Close out punch list acceptance	BIM Manager	BIM Manager	Project Team	Project Team, Project Manager, Owner
C	Acceptance of BIM uses	BIM Manager	Owner	Owner, BIM Committee	Owner, Project Team, BIM Committee
D	Incorporate BIM use in Organization	BIM Manager	Owner	Project Team	BIM Committee
E	Gather lessons learned and improve BIM standards	BIM Manager	BIM Manager	Project Team	BIM Committee

Close-Out

Input

- Finalized BEP (approved version)
- BIM Uses from responsible party (Architect, Contractor, or other)

Output

- Final record BIM use deliverable(s)
- Close out punch list acceptance (report, letter, email, or other documentation)
- Acceptance of BIM Uses
- Incorporated BIM use in owner's operational systems (records)
- Archive of project BIM use (by owner)

Execution

3D Coordination

Design Authoring

Facilities Management Data

Record Modeling

Existing Conditions Modeling

Design Review

Drawing Generation

Construction System Design

3D Coordination

3. Execution

3.1. 3D Coordination

3D Model and spatially coordinate* Mechanical, Electrical, Plumbing, and Fire trades with access requirements* for operations and maintenance work. Coordinated models will guide fabrication and ensure a clash-free* installation of construction trades.

*See terms in glossary

3.1.1. Content

Content of 3D Coordination shall be determined in the BIM Execution Plan (BEP) and aligned with BIM Forum Level of Development (LOD) specification and shall allow for sufficient detail to meet specific needs and particulars of the project. While exceptions may be considered per project, the minimum development level for model elements shall meet an LOD 300, while the minimum level of coordination planning shall be according to suggestions from AGC BIM Forum's 'MEP Spatial Coordination Requirements for Building Information Modeling', 2009. All installation shall be in alignment with the 3D Coordination model.

3.1.2. Format

Format of deliverables shall be in two parts:

1. Trade models making up final coordinated model, per naming standards
    a. all sharing common origin as indicated in the BEP and in coordination with the BIM Standards
    b. native file formats, per naming standard
    c. DWG and DWF
    d. interoperable format, such as STEP or VRML
    e. list of model enablers per file
2. Final federated / coordinated model (made up of trade models), per naming standards
    a. including O&M clearance boxes
    b. with equipment tags (named to correspond with applicable facilities data deliverables)
    c. matching campus coloring standards per trade and system
    d. containing selection sets per trade and system per standards
    e. NWD, NWF with associated linked models, DWF

Naming standards:

- Trade models shall be provided for each floor*, named per the following, and include the following model types as a minimum:
    - Name

- Building Number_Model Abbreviation_Level Number.File Ext
  - Level Numbers shall be two digit integers
  - Sitework Floor Number shall be “00”
- Ex: A06_M-DUCT_01.DWG

*exceptions may exist for breaking up floors in other ways and shall be documented in the BEP

- Model Types with Abbreviation
  - HVAC Duct: M-DUCT
  - HVAC Piping: M-PIPE
  - Plumbing: PLUMB
  - Fire Protection: FP
  - Electrical: ELEC
  - Framing: FRAME

- Federated / Coordinated model shall be provided for each floor, named per the following, and include the following model types with color at a minimum:
  - Name
    - Building Number_COORD_Level Number.File Ext
    - Ex: A06_COORD_01.NWD
  - Model Types
    - Include the same model types as mentioned in the trade model section.

Federated model selection sets and color standards:

Selection Set	Color / RGB	Selection Set	Color / RBG
Lighting	Yellow - 255;255;0	Electrical	Orange - 255;127;0
HVAC Equipment	Magenta - 255;0;255	HVAC Exhaust	Dark Green - 0;100;0
HVAC Supply Duct	Purple - 148;0;211	HVAC Return	Light Purple - 171;130;255
Chilled Water Supply	Blue - 0;0;205	Chilled Water Return	Light Blue - 176;226;255
Ceilings	White - 255;255;240	Framing	Purple - 147;112;219
Steel	Maroon - 176;48;96	Concrete	Grey - 190;190;190
Sanitary	Black - 0;0;0	Storm Drain / Rain Water	Peach - 255;218;185

3D Coordination

Domestic Water	Turquoise - 64;224;208	Domestic Hot Water	Teal - 0;128;128
Condenser Water Supply	Green - 0;205;0	Condenser Water Return	Light Green - 152;251;152
Fire Protection	Red - 255;0;0	Gas	Gold - 255;185;15
O&M Clearance	Peach- 255:218,185		

Models shall be set up consistently with georeference requirements, seen in Appendix G and with the BIM execution plan.

3.1.3. Responsibility

Responsible party for providing the deliverable shall be the Contractor and is also the responsible party for coordinating trades during the construction of the project.

Architect shall be responsible for providing architectural, structural, and civil models from construction document set to contractor when requested at the start of construction coordination efforts.

3.1.4. Process

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Provide architectural, structural, & civil models from CD set at start of coordination efforts	Architect	Architect	BIM Manager, Contractor	Project Team
B	Determine facilities involvement (document in BEP)	BIM Manager	Project Manager	Facilities Services	Project Team, BIM Committee
C	Determine subcontractor involvement (document in BEP)	Contractor	Contractor	BIM Manager, Subcontractor	Project Team
D	Determine tools & templates (document in BEP)	Contractor	Contractor	BIM Manager, Subcontractor	Project Team
E	Determine LOD for 3D Coordination (document in BEP)	Contractor	Contractor	Subcontractor	Project Team,

3D Coordination

ID	Task	Responsible	Accountable	Consulted	Informed
					BIM Manager
F	Determine implementation plan including: meeting plan, roles, and responsibilities for 3D Coordination (document in BEP)	Contractor	Contractor	Subcontractor	Project Team, BIM Manager
G	Hold BEP review meeting with all applicable trades	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager
H	Schedule, Lead, and Record 3D Coordination Meetings	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager
I	Oversee progress of Coordination Meetings and team collaboration	BIM Manager	Project Manager	Project Team	Owner
J	Maintain an FTP or similar accessible and record file sharing platform for posting and obtaining the latest trade models	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager
K	Keep current federated or combined trade files into a single model that is made available to project team	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager
L	Hold trades responsible to installation consistent with coordinated model	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager

Input

- project specific BIM Execution Plan (BEP)

Tools

- spatial coordination applications such as NavisWorks by AutoDesk or similar

Outputs

- a three dimensional representation governing how major trades will install respective work
- updated 3D coordination model to reflect any field changes at variance to original coordination model, LOD per the BEP, to be used as the 3D Coordination Record Model and in alignment with 3.1.2

Template

3D Coordination

- Contractor shall provide their own template consistent with these requirements and meeting at least the level of rigor set forth in this document

Example

- Documentation helping project teams manage 3D coordination efforts: AGC BIM Forum's 'MEP Spatial Coordination Requirements for Building Information Modeling', 2009
- Appendix 1.A - Construction Coordination Process Map Sample

3.2. Design Authoring

A process in which 3D software is used to develop a Building Information Model based on criteria that are important to the translation of the building's design. 3D Model and spatially coordinate* Mechanical, Electrical, Plumbing, Structural, Architectural and Civil disciplines to ensure clash-free* design prior to 100% contract documents.

*See terms in glossary

3.2.1. Content

Content of design authoring shall be determined in the BIM Execution Plan (BEP) and aligned with BIM Forum Level of Development (LOD) specification and shall allow for sufficient detail to meet specific needs and particulars of the project. While exceptions may be considered per project, minimum level of modeled detail shall meet LOD 300.

The design model shall be updated as the result of the 3D coordination process to appropriately reflect the approximate location, orientation, size, and quantity of elements represented in the coordination model. See 3.2.2 (Format) for disciplines expected to update their models for recording purposes. It is not expected that the design authoring model contain additional elements from 3D coordination models that are not in the design intent model. Rather, the design intent model remains to the same level of detail, yet adjusted to reflect coordination efforts.

3.2.2. Format

Format of design authoring deliverables shall be in their native file formats and at least two industry interoperable formats, such as IFC Coordination View, and as acceptable to the BIM Manager.

Models to be provided separately per discipline, as seen in the following deliverable table, and per the following naming standard:

Discipline	Abbreviation	File Name (Building Number_Abbreviation_Floor#.File Extension) **
Architecture	ARCH	A06_ARCH_01.RVT*
Structure	STRU	A06_STRU_01.RVT*
Mechanical	MECH	A06_MECH_01.RVT*
Electrical	ELEC	A06_ELEC_01.RVT*
Plumbing	PLUM	A06_PLUM_01.RVT*

Design Authoring

Civil	CIVL	A06_CIVL_00.DWG*

*Note that the above building number & file extensions are examples only.

** Floor # is an example of how models may be divided for size limitations, however, breaking up models by floor is not a requirement. Models shall be divided intuitively for each project, as the team finds necessary and documents in the BEP.

Models shall be set up consistently with georeference requirements, seen in Appendix G, and with the BIM execution plan.

3.2.3. Responsibility

Responsibility of design authoring shall rest upon the project architect and design lead.

3.2.4. Process

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Hold BEP review meeting with all applicable consultants	Architect	Architect	Consultant	Owner, Project Team, BIM Manager
B	Determine tools & templates (document in BEP)	Architect	Architect	BIM Manager, Consultants	Project Team
C	Determine Level of Detail (LOD) for design models (document in BEP)	Architect	BIM Manager	Contractor	Project Team
D	Schedule, Lead, and Record Design Coordination Meetings	Architect	Architect	Consultant	Owner, Project Team, BIM Manager
E	Maintain an FTP or similar accessible and record file sharing platform for posting and obtaining the latest models	Architect	Architect	Consultant	Owner, Project Team, BIM Manager
F	Hold consultants responsible to Coordinated Model	Architect	Architect	Consultant	Owner, Project Team, BIM Manager
G	Handover Deliverable at 100% CD	Architect	Architect	BIM Manager	Owner, Project Team, BIM Manager

Design Authoring

H	Handover Deliverable at Substantial	Architect	Architect	BIM Manager	Owner, Project Team, BIM Manager

Input

- project specific BIM Execution Plan (BEP)

Tools

- design authoring BIM applications
- spatial coordination applications such as NavisWorks by AutoDesk or similar

Outputs

- a three dimensional representation governing how design disciplines have designed and spatially coordinated their work
- a design model that has been updated to reflect 3D coordination modeling in approximate size, orientation, quantity and location of building systems to serve as the Design Authoring record model

Template

- Architect shall provide their own templates consistent with these requirements and meeting at least the level of rigor set forth in this document. Attach in BEP.

Example

- Refer to AIA E and G series exhibits associated with BIM protocols for guidance in coordinating BIM planning amongst design team members
- Appendix 2.A - Design Authoring Process Map Sample

3.3. Facilities Management Data

Organize space data (name, number, etc.), equipment data (name, description, location, model, manufacturer, serial number, etc.) and documents (drawings, submittals, operation maintenance, etc.) for delivery at substantial completion. The detail, format and extent of equipment, spaces, and documents shall be at a minimum as described in the appropriate appendices:

COBie vs. COBie Lite

COBie is an industry standard format for organizing construction information. There are many industry resources developed for helping project teams deliver COBie on projects within typical project software and workflows.

COBie Lite, as used in this section of the BIM standards, refers to a campus format applicable only to this owner. There are numerous references to COBie Lite in this section. Please understand that COBie Lite is being used as a derivative term to COBie and IS NOT referring to a specific industry standard format or process. The owner defines COBie Lite as a spreadsheet with one major sheet/tab for collecting an inventory of project equipment, and other sheets for collecting special attributes on project equipment. Teams tasked with delivering project data in COBie Lite may be requested by the owner to create such data within an owner provided web-tool / web-application instead of spreadsheet format; however, the fields of expected data will match what is seen on referenced COBie Lite requirements, samples, and templates.

For projects under five million dollars (or as identified in RFQ, RFP, and Agreements):

- Appendix 3.A - COBie Lite Data Requirements

For projects over five millions dollars (or as identified in RFQ, RFP, and Agreements):

- Appendix 3.B - COBie Data Requirements

3.3.1. Content

Equipment, spaces, and documents relative to operation and maintenance of the building shall be provided to the owner at substantial completion and to the detail and extent described in appendices 3.A & 3.B.

All equipment classifications that should be captured in the project facilities management data deliverable are represented in the Owner's Asset Classifications & Attributes, seen in Appendix 3.C. In so much as an asset classification from the owner's asset classification table appears in the project, it should be captured in the data to be delivered to the owner. It should be noted that the project will also be nominating

additional asset classifications in the project that is not identified in the owner's classification table, as described in the RACI table to follow.

3.3.2. Format

Format of the Facilities Management data is to be named and ordered according to appendices 3.A, 3.B, & 3.C.

3.3.3. Responsibility

Responsibility of the Facilities Management data is shared across project participants and can be reviewed in detail in appendices 3.A & 3.B.

3.3.4. Process

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Set FM data review schedule (document in BEP)	BIM Manager	Project Manager	Contractor	Project Team
B	Set FM data test import schedule (document in BEP)	BIM Manager	Project Manager	CMMS Manager	CMMS Manager
C	Determine consultant involvement (document in BEP)	Architect	Architect	BIM Manager, Consultants	Project Team
D	Determine tools & templates (document in BEP)	Architect	Architect	BIM Manager, Consultants	Project Team
E	Hold kick-off meeting with all applicable consultants	Architect	Architect	Consultant	Owner, Project Team, BIM Manager
F	Select Equipment Groups / Classes from Owner's Asset Classifications (document in BEP)	Architect	Architect	BIM Manager, Consultants	Project Team
G	Schedule, coordinate team, and record Design Data	Architect	Architect	Consultants	Owner, Project Team, BIM Manager

Facilities Management Data

ID	Task	Responsible	Accountable	Consulted	Informed
H	Provide iterative Design Data for review meetings	Architect	Architect	Consultants	Owner, Project Team, BIM Manager
I	Provide final Design Data to Contractor	Architect	Architect	Contractor	Owner, Project Team, BIM Manager
J	Determine subcontractor involvement (document in BEP)	Contractor	Contractor	BIM Manager, Subcontractor	Project Team
K	Determine tools & templates (document in BEP)	Contractor	Contractor	BIM Manager, Subcontractor	Project Team
L	Hold kick-off meeting with all applicable trades	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager
M	Schedule, coordinate team, and record Construction Data	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager
N	Provide iterative Construction Data for review meetings	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager
O	Integrate Construction Data reviews into field inspections	Contractor	Contractor	Subcontractor	Owner, Project Team, BIM Manager
P	Review and Comment on Design & Construction Data	BIM Manager	Project Manager	CMMS Manager, Space Manager	Project Team, Owner

Input

- project specific BIM Execution Plan (BEP) - identifies the parties responsible for collecting the data, the scheduled review meetings, and the plan/process for collecting the day (Appendix F)
- COBie Lite Requirements - Appendix 3.A
- COBie Requirements - Appendix 3.B
- Asset Classifications & Attributes - Appendix 3.C

Tools

- minimum: tabular data editing software such as Microsoft Excel
- SAAS: Onuma, EcoDomus, BIM 360 Field, and others.

Outputs

- COBie / COBie Lite excel file for the owner to populate their CMMS, help plan for maintenance, track warranties, and operate the building
- electronic documents of Operations & Maintenance Manuals, grouped in folders by the first level of MasterFormat categories (ex: 03 - Concrete, 22 - Plumbing, etc.) and in alignment with COBie / COBie Lite referenced attachments
- COBie & COBie Lite files shall be named as such:
    - Building NumberName.xls
    - C26.xls

Template

- see Appendix 3.D for COBie Lite Template 1.0
- see Appendix 3.E for COBie Template 2.4

Example

- see Appendix 3.F for Example COBie Lite 1.0
- see Appendix 3.G for Example COBie 2.4
- see Appendix 3.H for FM Data Process Map Sample

3.4. Record Modeling

Record Modeling is the process used to depict an accurate representation of the physical conditions, environment, and assets of a facility.

The record model should, at a minimum, consistently capture all BIM files and information relating to implemented BIM uses on the project. It is the culmination of all the BIM Modeling throughout the project, and delivers records to the owner to support operational functions and future work affecting the facility. Record deliverables from BIM uses will be described (with content, format, responsibility) in each of the respective BIM use sections in other parts of these standards.

Additionally, the Record Modeling BIM use requires BIM files that enable certain operational systems, such as space planning, and are expected in a particular format from the project team in order to meet system input requirements.

An important aspect of Record Modeling is the update of operational files to the current state of the facility. The project participant responsible for producing the BIM use (see other sections) is also the responsible party for updating record BIM files (if they exist) to indicate the following:

- identify old model objects to be updated, and include demark locations for old vs. new cutoff points
-

3.4.1. Content

<u>Record Model</u>
Record models shall be obtained from the appropriate responsible project team participants as deliverables under that project BIM use. As such, details regarding content for those deliverables are contained in the respective BIM use sections.

<u>Space Planning</u>
The Building Information Model shall include a set of space plan views for each floor level to be used by the Archibus space database as a system of record. The space plan views shall be shown with a simple level of detail with tags only for rooms. (See Facilities Standards Section IV.E.9 Sample Space Plan for LOD example.)

Deliverables shall be sufficient to support Space Planning requirements as seen in Facilities Standards Sections:

- IV.E.1 Room Number Assignment Guidelines
- IV.E.2 Building Measurement Standards Policy
- IV.E.10 Space Plan Layer Names

Gross and Net areas shall be measured according to Facilities Standards Section IV.E.2 Building Measurement Standards Policy, which follows the Post-secondary Education Facilities Inventory and Classification Manual (FICM) space measurement standards. Room objects should cover all the interior floor space bounded by interior partitions and exterior walls. These should include elevators at every level, stairs, and all office cubicles. Room separators shall be used in the model where invisible boundaries divide different room types. The room object volumes should be extruded upward to the bottom of the finished ceiling height.

Each room object in the space plan shall be identified by tag with a room number that is unique within the building. Room numbering should follow Facilities Standards Section IV.E.1 Room Number Assignment Guidelines.

Room categories and room types should conform to The Post-secondary Education Facilities Inventory and Classification Manual (FICM) space categories. If the FICM room types are not sufficiently specific to the needs of the project, room types following OmniClass or other standard may be added in the room schedule in addition to, but not replacing, the FICM room types. Room area tags in the space plan should display: Room number, department (if determined), FICM room type, and FICM room area.

In projects with planned departmental assignments, each space will also receive a departmental name and code number to be entered in the room schedule and displayed on the room tags. The department names and code numbers will be provided by the project manager as needed.

Deliverable shall match final as-built state of facility spaces.

BIM System of Record

BIM System of Record shall be the store of all BIM uses of a project, and shall allow for ease of access of all visual BIM deliverables in a simple viewer.

3.4.2. Format

Record Model

Record models shall be obtained from the appropriate responsible project team participants as deliverables under that project BIM use. As such, details regarding format for those deliverables are contained in the respective BIM use sections.

Space Planning

Provide deliverable according to requirements seen in Facility Standards Sections called out in 3.1.4.1. Building Information Models from the architect and/or contractor shall be delivered in formats specified in Facilities Standards Section IV.E.6 Closeout Documents Guide. The space plan views in the architect's building information model shall also be exported to AutoCAD 2013 for use in the Archibus Space Database System of Record. The exported CAD space plans shall include room area polylines in the export settings. CAD layers in the exported space plans should follow Facilities Standards Section IV.E.10 Space Plan Layer Names (which is a subset of AIA layers in the National CAD Standard).

BIM System of Record

BIM System of Record shall be formatted in the following folder structure:

- ❏ Building Name
  - ❏ BIM Use Name
    - ❏ System Name
      - ❏ File Name

The following System Names shall be used in folder naming (IF APPLICABLE):

Architecture	Structure	Electrical
Plumbing	Mechanical	Civil
Whole Building	Other	

A text file shall be included in the parent building folder to hold record for any changes that are to be made to files. Text file shall include total list of project BIM deliverables, location of BIM deliverables in folder hierarchy, and describe file changes in regards to what and why files are added, edited, or have been deleted.

3.4.3. Responsibility

Record Model

Record models shall be obtained from the appropriate responsible project team participants as deliverables under that project BIM use. As such, details regarding responsibility, and process for those deliverables are contained in the respective BIM use sections.

Also, the following parties shall be responsible for additional BIM use deliverables:

Space Planning: Architect

BIM System of Record: BIM Manager

3.4.4. Process

See deliverables and process matrix in Facilities Standards Section III.E Information Resources for contents and timing of each task.

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	BIM Deliverables posted to E-builder	Architect, Contractor	BIM Manager	Project Team	BIM Manager, BIM Committee
B	Confirm Room Numbering and Naming meet standards	BIM Manager	BIM Manager	BIM Committee Architect	Project Team, Space Planning
C	Space Plan BIM & CAD deliverables at bid phase	Architect	Project Manager	BIM Manager, Space Planning	BIM Committee, Space Planning
D	Space Plan BIM & CAD deliverables at close-out	Architect	Project Manager	BIM Manager, Space Planning	BIM Committee, Space Planning
E	Organize all project BIM deliverables into system record folders	BIM Manager	Project Manager	Project Team	BIM Committee
F	Populate BIM system of record for all BIM uses on project	BIM Manager	BIM Manager	BIM Committee	BIM Committee

Input

- BEP to identify which BIM uses will be implemented on the project and their associated expected date of delivery

Tools

- Model aggregation software such as Autodesk Navisworks for system of record
- AutoCAD to verify space planning deliverable
- Owner server available for storage of BIM uses

Output

- Organized BIM use deliverables per System of Record folder structure
- Populated BIM viewer for organizational viewing
- Populated Space Planning system from project deliverable, AutoCAD 2013
- Additional models/CAD files that are not included from other BIM uses that are produced by AEC professionals for the project

Template

- N/A

Example

- Appendix 4.A - BIM System of Record Folder Structure Example
- Facilities Services Section IV.E.9 Sample Space Plan
- Appendix 4.B - Record Model Process Map Sample
- Appendix 4.C - Space Planning example

3.5. Existing Conditions Modeling

A process in which a project team develops a 3D model of the existing conditions for a site, facilities on a site, or a specific area within a facility. This model can be developed in multiple ways: including laser scanning and conventional surveying techniques, depending on what is desired and what is most efficient. Once the model is constructed, it may be queried for information, whether it is for new construction or a modernization project. Existing Conditions Modeling aims to provide only the necessary information to allow successful design and construction for that particular project.

3.5.1. Content

Existing Conditions Modeling shall be utilized to an appropriate level of detail, and with consideration for the particular needs of the project. Every project, utilizing the BIM use will require varying levels of detail. Level of detail will be determined during the BEP process under the direction of the Architect. However, the minimum level of detail per building system and/or element may be decided prior to selection of Design team; in which that information will be relayed during the RFQ / selection process.

3.5.2. Format

3D or BIM model of existing condition in authoring tool, which shall have the following as deliverables upon completion of that model:

- native format (ex: RVT, PLN, DWG, etc.)
- at least two other interoperable formats (IFC Coordination View, BCF, etc.)

Models shall be set up consistently with georeference requirements, seen in Appendix G, and with the BIM execution plan.

3.5.3. Responsibility

The Architect will be responsible for producing the existing conditions model and managing those associated efforts. However, it will be acceptable if the architect manages another member of their team to perform what is necessary.

3.5.4. Process

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Suggest level of detail and areas to be modeled	Architect	Architect	BIM Manager, Contractor (if available)	BIM Committee, Project Manager

Existing Conditions Modeling

ID	Task	Responsible	Accountable	Consulted	Informed
B	Scan existing areas and incorporate into model	Architect	Architect	BIM Manager, Contractor (if available)	BIM Committee, Project Manager
C	Handover existing conditions model as record	Architect	Architect	BIM Manager	BIM Committee
D	Review and comment on existing conditions model	BIM Manager	Project Manager	Architect	Project Team, BIM Committee

Input

- RFQ and other qualification / proposal documents
- BEP - BIM Execution Plan

Tools

- Total stations
- Laser scanner
- Point cloud converter (to objects)
- BIM authoring tools

Output

- 3D Model will enable design team to properly coordinate design with existing conditions of the facility
- Point cloud data, if generated from the BIM use, shall also be a deliverable with the 3D Model and shall have the same origin, scale, and orientation requirements as the model

Template

- N/A

Example

- Appendix 5.A - Existing Conditions Model Sample
- Appendix 5.B - Existing Conditions Process Map Sample

3.6. Design Review

A process in which stakeholders view a 3D model and provide their feedback to validate multiple design aspects. These aspects may include evaluating meeting the program, previewing space aesthetics and layout in a virtual environment, and setting criteria such as layout, sightlines, lighting, security, ergonomics, acoustics, textures and colors, etc.

This BIM use can be done by using computer software only or with special virtual mock-up facilities, such as CAVE (Computer Assisted Virtual Environment) and immersive lab.

3.6.1. Content

Design Reviews shall involve all stakeholders who are expected to provide critical comments regarding aesthetics, system layout and design, constructability, and operational needs of the facility. Modeled content made available for review shall provide sufficient detail to allow for reviewer comments and shall be consistent with content made available in the drawing reviews.

3.6.2. Format

Design reviews shall be provided in meeting form and also web form according to what is appropriate for the reviewing audience. Specific review meetings shall be outlined in the BEP, and may be acceptable as a web meeting if approved by the BIM Manager and Project Manager. Meeting format shall be similar to a ‘page-turn’ design review where the meeting organizer will provide a guided group tour / visual of the areas to be reviewed. Web models shall be viewable within a standard browser or made available as a standard viewable format (such as NWD, BIMx, etc.) as approved by the BIM Manager in the BEP process. Model visualizations may be pre-rendered for Architectural reviews, but shall be live for technical reviews such as system design reviews.

Reviews selected in the BEP shall consider, at a minimum, the following topics for SD, DD, and CD review:

- Architectural (interior, exterior, furniture)
- MEP Systems

CAVE Review

Some large projects with significant impact to the campus environment will be elected to use CAVE Reviews, which provides for a more immersive modeling review session. Projects participants engaged in CAVE reviews should expect to provide a lighting and texture environment in an interoperable format (FBX, etc.) that supports the Organizational CAVE hardware and software system.

Additional details for supporting CAVE reviews will be worked out during the BEP, along with the determination of which reviews should be CAVE vs. traditional BIM review.

3.6.3. Responsibility

Design review process and models shall be lead and performed by the Architect.

3.6.4. Process

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Determine Design Review types and formats (document in BEP)	Architect	Architect	Project Manager, BIM Manager, Project Team	BIM Committee, Stakeholders
B	Schedule Design Review meetings (document in BEP)	Architect	Architect	Project Manager, Stakeholders	BIM Manager, Stakeholders
C	Prepare models for review meeting and make accessible to reviewers	Architect	Architect	Project Manager, Stakeholders	BIM Manager, Stakeholders
D	Review and comment on success of meetings	BIM Manager	Project Manager	Owner, Stakeholders Project Team	Project Team

Design Review

Input

- BEP - BIM Execution Plan

Tools

- Model Viewer (ex: Navisworks, Solibri, etc.)
- CAVE (ex: Unity 5, etc.)

Output

- Informed stakeholders that better visualize the content requesting their comments and approval. More informed and detailed comments from design reviewers.

Template

- N/A

Example

- Appendix 6.A - Design Review Sample
- Appendix 6.B - Design Review Process Map Sample

3.7. Drawing Generation

A process in which building information modeling and the model itself is used to create drawings and drawing sets. This including Schematic, Design Development, and Construction Drawings.

The same building model can be used to create all drawing, reports, and analysis datasets. This eliminates the need to manually update each drawing for each design change. Additionally standard construction details can be generated directly from the model, however it may be necessary to add additional information that is not contained within the facility model.

3.7.1. Content

All disciplines engaged in BIM Authoring, shall be required to produce drawing sets from the BIM model. RFIs and ASIs shall be generated from the model if drawings require re-issuing and a sketch will not suffice.

3.7.2. Format

Drawings generated from the model shall be in alignment with other owner requirements.

3.7.3. Responsibility

Drawing generation is the responsibility of the Architect.

3.7.4. Process

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Provide necessary communication requirements and workflow details in BEP	Architect	Architect	Project Team, BIM Manager	Project Team, BIM Manager
B	Produce major drawing sets from design BIM	Architect	Architect	Project Team, Project Manager	BIM Manager
C	Produce re-issued drawings from BIM	Architect	Architect	Project Team, Project Manager	BIM Manager

Input

- BEP - BIM Execution Plan

Tools

- Design authoring BIM tools (Revit, ArchiCAD, etc.)

Output

- Quality drawings that are coordinated, efficiently created, and are quickly updated as design progresses

Template

- N/A

Example

- Appendix 7.A - Drawing Generation Process Map

3.8. Construction System Design

A process in which 3D System Design Software is used to design and analyze the construction of a complex building system (e.g. formwork, glazing, tie-backs, etc.) in order to increase planning.

3.8.1. Content

Virtual mock-ups shall involve all stakeholders who are expected to provide review and approval in a typical mock-up scenario. The virtual mock-up shall also be to the appropriate level of detail to replicate what would be available in a physical mock-up.

3.8.2. Format

Virtual mock-ups shall be provided in either pre-rendered or for live viewing such that they are created in a way to be useful in preventing the creation of physical mock-ups.

3.8.3. Responsibility

Virtual mock-ups shall be performed by the Contractor.

3.8.4. Process

Roles (RACI)

ID	Task	Responsible	Accountable	Consulted	Informed
A	Determine when virtual mock-ups will be appropriate (document in BEP)	Contractor	Contractor	Architect, Project Manager, Project Team	BIM Manager, Stakeholders
B	Schedule virtual mock-up schedule	Contractor	Contractor	Architect, Project Manager, Project Team	BIM Manager, Stakeholders
C	Prepare virtual mock-ups where a physical mock-up may be prevented	Contractor	Contractor	Architect, Project Manager, Project Team	BIM Manager, Stakeholders

Input

- BEP - BIM Execution Plan

Tools

- Model Viewer (ex: Navisworks, Solibri, etc.)

Output

- Informed stakeholders that better visualize the content requesting their comments and approval. More informed and detailed comments from mock-up reviewers.

Template

- N/A

Example

- Appendix 8.A - Virtual Mock-up Sample
- Appendix 8.B - Construction System Process Flow Sample

Glossary

4. Glossary

Building Information Modeling (BIM) – The efficient use of technology to manage and share facility information and geometry during its life-cycle.

BIM Use - a method or strategy of applying Building Information Modeling during a facility's lifecycle to achieve one or more specific objectives.

Clash – The spatial overlap of building elements that prohibit installation or operation & maintenance activities.

CMMS - (Computerized Maintenance Management Software) an application used by the owner to manage maintenance and operations of buildings and their associated equipment

COBie - Construction to Operations Building information exchange (COBie) is an industry standard that allows for a consistent way of organizing facility data from the project. The facility data, may be imported into systems, such as asset management software to provide facilities teams valuable information to maintain and operate the facility.

RACI – acronym standing for Responsible, Accountable, Consulted, Informed. RACI is a method for establishing clear lines of responsibility in a project. Responsible is the person(s) who is responsible for delivering/performing the activity, Accountable is the person who has authority over the task or deliverable and will be the person "R" is responsible to. Consulted is the person(s) whose expertise is needed to perform the task. Informed is the person(s) who will need to be informed of the task once it is complete.

RFP - a formal solicitation or invitation by an entity interested in procurement of a service to potential suppliers to submit business proposals.

RFQ - a formal solicitation or invitation by an entity interested in procurement of a service to potential suppliers to submit pre-qualifications.

Spatially Coordinate – The activity of assembling 3D modeled building systems to ensure a clash-free environment across design disciplines or construction trades.

Roles:

Access Requirements for Operation & Maintenance – The required spatial voids to allow for an averaged sized person to perform routine maintenance on MEPF equipment

Architect - the entity responsible for managing the design of the project

BIM Committee- staff members responsible to for providing oversight of BIM program across organization. The BIM Manager reports to the BIM Committee.

BIM Manager - staff (augmented or within organization) that is responsible for managing all BIM related components for the Owner on the project.

Glossary

CMMS Manager - staff that is responsible for managing the use and upkeep of the CMMS

Contractor - the entity responsible for managing the physical construction of the project.

Project Manager- the project management entity representing the owner and overseeing the project during its life cycle.

Project Team - all major participants of the project, including: Contractor, Architect, Owner, BIM Manager, etc..

Owner - the end user who is receiving the project and is responsible for managing of it for the intended use.

Subcontractor- the various trades responsible for providing materials and labor on the project

5. Appendix

Process

- Appendix A - BIM Use Determination Matrix
- Appendix B - Sample language for RFQ
- Appendix C - Sample language for RFP
- Appendix D - Sample language for design contracts
- Appendix E - Sample language for construction contracts
- Appendix F - BIM Execution Plan (BEP) template
- Appendix G - Model Geo-Reference

Execution

- Appendix 1.A - Construction Coordination Process Map Sample
- Appendix 2.A - Design Authoring Process Map Sample
- Appendix 3.A - COBie Lite Requirements
- Appendix 3.B - COBie Requirements
- Appendix 3.C - Asset Classifications and Attributes
- Appendix 3.D - COBie_Lite_Template_1.0.xls
- Appendix 3.E - COBie_Template_2.4.xls
- Appendix 3.F - Example_COBie_Lite_1.0.xls
- Appendix 3.G - Example_COBie_2.4.xls
- Appendix 3.H - FM Data Process Map Sample
- Appendix 4.A - BIM System of Record Folder Structure Example
- Appendix 4.B - Record Model Process Map Sample
- Appendix 4.C - Space Planning example
- Appendix 5.A - Existing Conditions Model Sample
- Appendix 5.B - Existing Conditions Process Map Sample
- Appendix 6.A - Design Review Sample
- Appendix 6.B - Design Review Process Map Sample
- Appendix 7.A - Drawing Generation Process Map
- Appendix 8.A - Virtual Mock-up Sample
- Appendix 8.B - Construction System Process Flow Sample

Acknowledgements

6. Acknowledgements

During the compilation of these requirements, regular review of industry standard documents were performed to align expectations with the BIM community across the country. Some of those standards that were reviewed, greatly influenced the choice of wording seen in this specification. Word selection, and in some cases phrase and sentence alignment, was done to provide consistency with industry accepted documents and allow for cross referencing of common requirements.

Below is a list of commonly reviewed and referenced industry documents and standards:

AIA

AIA BIM Protocol

http://www.aia.org/contractdocs/referencematerial/aiab099135

http://www.aia.org/contractdocs/referencematerial/aiab099136

BIM Forum

Level of Development

https://bimforum.org/lod/

MEP Spatial Coordination Requirements for Building Information Modeling', 2009

http://bimforum.org/wp-content/uploads/2011/02/MEP-Spatial-Coordination-Requirements-for-Building-Information-Modeling.pdf

National Institute for Building Sciences

National BIM Standards

http://www.nationalbimstandard.org/

Pennsylvania State University

BIM Execution Planning

http://bim.psu.edu/