

Module 3:

BIM Execution Planning (BEP)

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Learning objectives of this lecture

- What is a BIM Execution Plan (BxP)?
- How to develop a BxP?
- BIM goals & BIM Uses
- BIM Processes

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Contracting (BIM Addenda)

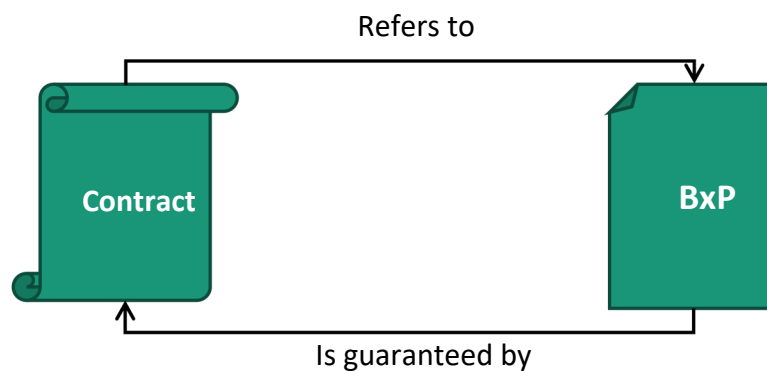
How should BIM be written into the future contracts?

- Through **BIM Addenda**
 - AIA E202 and E203
 - AGC ConsensusDocs 301
 - DBIA E-BIMWD
 - Etc.

- Pay attention to:
 - Model development & responsibilities of parties involved;
 - Model sharing & model reliability;
 - Interoperability/file format;
 - Model management;
 - Intellectual property rights;
 - ...
 - **Requirement for BxP!**
 -

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BIM Execution Plan (BxP)



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What is BxP?

- Action plan for the success in applying BIM!
- “A structured procedure for creating & implementing a BIM project, along with a detailed design & documentation of the process for executing BIM throughout a facility’s lifecycle.”
- BIM Execution Plan is:
 - A document outside the governing contracts and BIM addenda;
 - Based on the goals defined by the owner and the team (in the contract).

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What is BxP?

- BxP defines:
 - How the **team & software** will **communicate**;
 - What the **expectations** of the team are;
 - How the **information** is organized.
- An industry-wide standard template.
- Roadmap to attain BIM Implementation.

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What goes into a BxP?

- 14 components!

BIM Project Execution Plan	
Categories	
1	BIM Project Execution Plan Overview
2	Project Information
3	Key Project Contacts
4	Project Goals / BIM Uses
5	Organizational Roles / Staffing
6	BIM Process Design
7	BIM Information Exchanges
8	BIM and Facility Data Requirements
9	Collaboration Procedures
10	Quality Control
11	Technological Infrastructure Needs
12	Model Structure
13	Project Deliverables
14	Delivery Strategy / Contract

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BxP Templates

- PennState University
 - PennStateBIMProjectExecution Planning Guide



- Autodesk®
 - AutodeskCommunication Specification



... others

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PennState BxP Guide

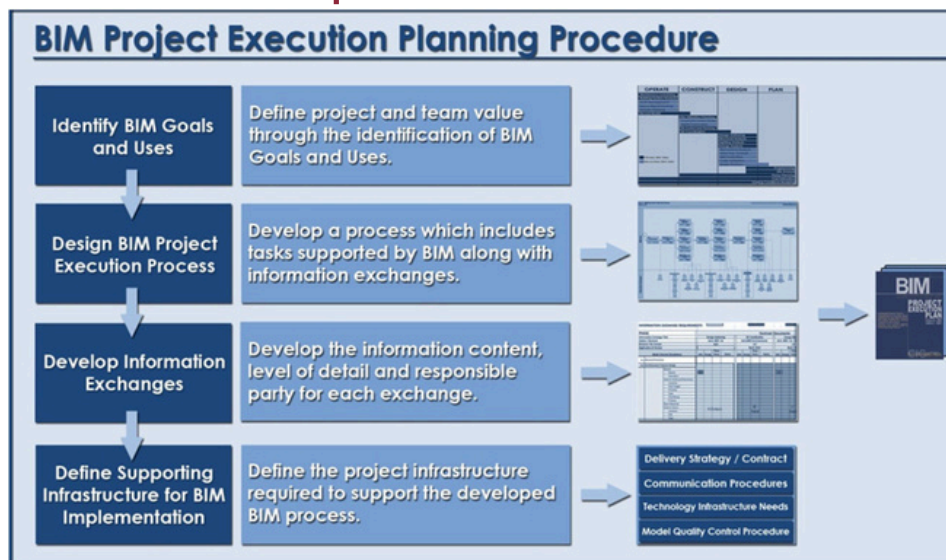
- Designed to steer:
 - Owners
 - Program managers
 - Early project participants



- Developed through a multi-step research process
 - Industry interviews with over 40 experts;
 - Detailed analysis of existing planning documents;
 - Focus group meetings with industry participants;
 - Process mapping research;
 - Case study research for validation;

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How to develop a BxP?



Source: PennStateBIM Execution Planning Guide

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How to develop a BxP?

- The procedure (four steps):
 1. Identify **BIM goals&uses**;
 2. Design BIM execution **process**;
 3. Define BIM deliverables in form of **information exchanges**;
 4. Develop the **supporting infrastructure** for BIM development.

(BIM Meetings)

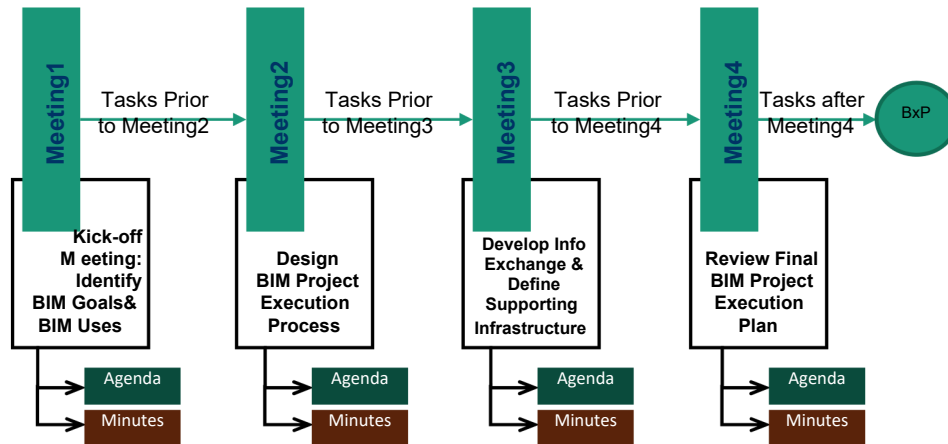
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Meetings to successfully develop a BxP

- A Minimum of three
- Kick-off meeting (the 1st one):
 - Key decision makers for all organizations
- Follow up meetings
 - Fewer people
 - More targeted on execution details

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BxPdevelopment meetings



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BIM Goals and BIM Uses

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Step1 –Identifying BIM Goals/BIM Uses



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BIM Goals

Potential values of using BIM on the project

- Project goals related to BIM – must:
 - be specific to the project;
 - be measurable;
 - improve the success.

- Two general categories:
 - Related to the **PROJECT** general performance;
 - Related to improving capabilities of the **PROJECT TEAM**.

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[typical] BIM Goals

- Team collaboration
- Model existing condition
- Design (Conceptual design; Schematic design; Design Development)
- Design documentation
- Constructability
- Coordination with Contractor & Subs
- Facilities management

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BIM Goals –Example

- Strategic
 - Ensure a high quality of design and design documentation
- Project related
 - Increase field productivity
- Value oriented
 - Accurately track the progress of construction
 - Develop an accurate record of the final building design for use during the operation
 - Achieve sustainability targets
 - Effectively check compliance with the fire code and disability act
 - Accurately review the cost impact of changes in a timely manner

How can these goals be achieved in practice?



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BIM Uses

The appropriate “tasks” the team would like to perform, using BIM (to achieve the BIM goals)

- □ 21 (25) BIM uses are provided by PennStateBxPguide.

For each, is also listed:

- Potential values (BIM goals);
- Resources required;
- Team competencies.

Site Analysis
Description: A process in which BIM/GIS tools are used to evaluate properties in a given area to determine the most optimal site location for a future project. The site data collected is used to first select the site and then position the building based on other criteria.
Potential Value: <ul style="list-style-type: none">▪ Use calculated decision making to determine if potential sites meet the required criteria according to project requirements, technical factors, and financial factors▪ Decrease costs of utility demand and demolition▪ Increase energy efficiency▪ Minimize risk of hazardous material▪ Maximize return on investment
Resources Required: GIS software Design Authoring Software
Team Competencies Required: <ul style="list-style-type: none">▪ Ability to manipulate, navigate, and review a 3D model▪ Knowledge and understanding of local authority's system (GIS, database information)

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Identifying BIM Uses

- **Begin from The End in mind!!**
 - Future use of the information
 - Impacts the model development
- Identify appropriate BIM Uses with the potential end-users of the information in the model
- Start from later phases of the project and move backward
- - What information might be needed at each phase?
 - What must be done in the earlier phases to support that?

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STEP1) Identifying BIM Uses

OPERATE	CONSTRUCT	DESIGN	PLAN
Maintenance Scheduling			
Building System Analysis			
Asset Management			
Space Mgmt/Tracking			
Disaster Planning			
Record Model			
	Site Utilization Planning		
	Construction System Design		
	Digital Fabrication		
	3D Control and Planning		
	3D Coordination		
		Design Authoring	
		Energy Analysis	
		Structural Analysis	
		Lighting Analysis	
		Mechanical Analysis	
		Other Eng. Analysis	
		LEED Evaluation	
		Code Validation	
		Design Reviews	
			Programming
			Site Analysis
			Phase Planning
			Cost Estimation
			Existing Conditions Modeling

Primary BIM Uses
 Secondary BIM Uses

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STEP1) Identify BIM Uses

AsystematicApproach – 5 sub-steps:

1. Identify the potential BIM Uses;
2. Identify the responsible parties for each potential BIM Use;
3. Rate the capabilities of each party for each BIM Use;
4. Identify additional value & risk associated with each Use;
5. Determine whether or not to implement each BIM Use.

BIM Use Selection
Worksheet

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STEP1) Identify BIM Uses

□ SubStep1 –Identify the potential BIM Uses

- Copy form the BIMGoal Identification Worksheet;
- Define the BIM Uses in relationwiththeGoals(Valueaddedobjectives);
- Consult with the BIM Use descriptions;
- Rate the value to the project(priority): High/Med/Low.

Project Goal
Ensure a high quality of design and design documentation
Increase field productivity
Accurately track the progress of construction
Develop an accurate record of the final building design for use during the operation
Achieve sustainability targets
Effectively check compliance with the fire code and disability act
Accurately review the cost impact of changes in a timely manner

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STEP1) Identify BIM Uses

□ SubStep2 –Identifytheresponsibleparties for each potential BIM Use

- @ least one responsible party for each Use
- Lead responsible party on top of the list
- Any team member involved in the Use if performed
- Potential outside participants required to assist
- Rate the value of each Use to each party (High/Med/Low)

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STEP1) Identify BIM Uses

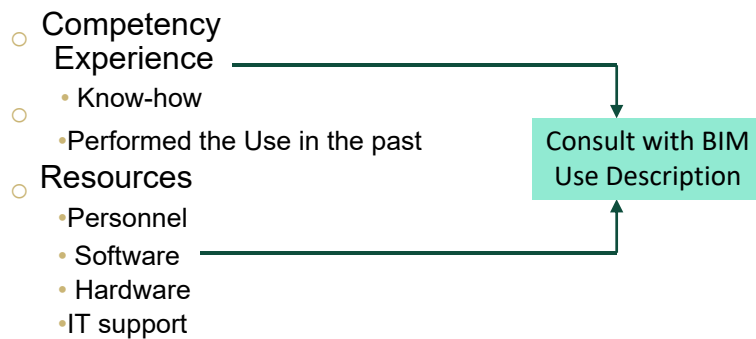
- **SubStep2** – Identify the responsible parties for each potential BIM Use

BIM Use*	Value to Project	Responsible Party	Value to Resp Party
	High / Med / Low		High / Med / Low
Record Modeling	HIGH	Contractor	MED
		Facility Manager	HIGH
		Designer	MED
Cost Estimation	MED	Contractor	HIGH
4D Modeling	HIGH	Contractor	HIGH
3D Coordination (Construction)	HIGH	Contractor	HIGH
		Subcontractors	HIGH
		Designer	MED

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STEP1) Identify BIM Uses

- **SubStep3** – Rate (1~3, 1:low) the capabilities of each party for each BIM Use –based on:



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STEP1) Identify BIM Uses

- **SubStep3**—Rate(1~3,1:low)thecapabilities of each party for each BIM Use

BIM Use*	Value to Project	Responsible Party	Value to Resp Party	Capability Rating		
				Scale 1-3 (1 = Low)		
	High / Med / Low		High / Med / Low	Resources	Competency	Experience
Record Modeling	HIGH	Contractor	MED	2	2	2
		Facility Manager	HIGH	1	2	1
		Designer	MED	3	3	3
Cost Estimation	MED	Contractor	HIGH	2	1	1
4D Modeling	HIGH	Contractor	HIGH	3	2	2
3D Coordination (Construction)	HIGH	Contractor	HIGH	3	3	3
		Subcontractors	HIGH	1	3	3
		Designer	MED	2	3	3

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STEP1) Identify BIM Uses

- **SubStep4**—Identifyadditionalvalue&risk associated with each Use
 - Additional resources / competenciesrequiredfortheteams;
 - Additional values (Notes);
 - Risks involved (Notes).

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STEP1) Identify BIM Uses

□ SubStep4 – Identify additional value & risk associated with each Use

BIM Use*	Value to Project	Responsible Party	Value to Resp Party	Capability Rating			Additional Resources / Competencies Required to Implement	Notes
				Scale 1-3 (1 = Low)				
	High / Med / Low		High / Med / Low	Resources	Competency	Experience		
Record Modeling	HIGH	Contractor	MED	2	2	2	Requires training and software	
		Facility Manager	HIGH	1	2	1	Requires training and software	
		Designer	MED	3	3	3		
Cost Estimation	MED	Contractor	HIGH	2	1	1		
4D Modeling	HIGH	Contractor	HIGH	3	2	2	Need training on latest software	High value to owner due to phasing complications
							Infrastructure needs	Use for Phasing & Construction
3D Coordination (Construction)	HIGH	Contractor	HIGH	3	3	3		
		Subcontractors	HIGH	1	3	3	conversion to Digital Fab required	Modeling learning curve possible
		Designer	MED	2	3	3		

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STEP1) Identify BIM Uses

□ SubStep5 – Determine whether or not to implement each BIM Use

Use

- Discuss each Use with the team:
 - Benefits VS cost;
 - Risk of applying VS not applying;
 - Risk transfer...
- Go/no go decision on each Use!



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STEP1) Identify BIM Uses

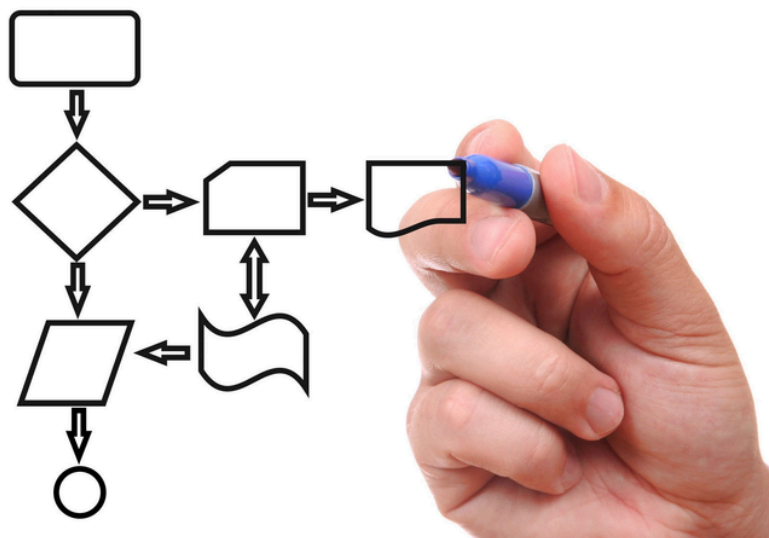
SUMMARY – BIM Use Analysis Worksheet

BIM Use*	Value to Project	Responsible Party	Value to Resp Party	Capability Rating	Additional Resources / Competencies Required to Implement	Notes	Proceed with Use
	High / Med / Low		High / Med / Low	Scale 1-3 (1= Low)			YES / NO / MAYBE
Record Modeling	HIGH	Contractor	MED	2	2	Requires training and software	YES
Cost Estimation	MED	Contractor				Requires training and software	NO
4D Modeling	HIGH	Contractor	HIGH	3	2	Need training on latest software infrastructure needs	YES
BIM Coordination (Constructors)	MED	Contractor	HIGH	3	3	conversion to Digital P all required	YES
Design Review	MED	Design Manager / Designer	LOW	1	1	Review to be done in a mobile	NO
Structural Engineer / Civil Engineer	HIGH / LOW					Large learning curve	
Programming	MED					Planning Phase Complete	NO

BIM Use Selection Worksheet

- STEP1)** Identify the potential BIM Uses & their value to project
- STEP2)** Identify the responsible parties for each potential BIM Use
- STEP3)** Rate the capabilities of each party for each BIM Use
- STEP4)** Identify additional value & risk associated with each Use
- STEP5)** Determine whether or not to implement each BIM Use

Step2 – Designing BIM Processes



STEP2) Design BIM Processes

What happens after identifying BIM Uses?

Understanding the implementation **process**:

(Level1)

- Understand the overall BIM execution process;

(Level2)

- Define the process(es) required for each BIM Use.

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STEP2) Design BIM Processes

□ Level 1: BIM Overview Map

- One created for the whole project
- Relationship between BIM Uses which will be employed
- High level information exchanges throughout the project lifecycle

□ Level2: Detailed BIM Use processes Map

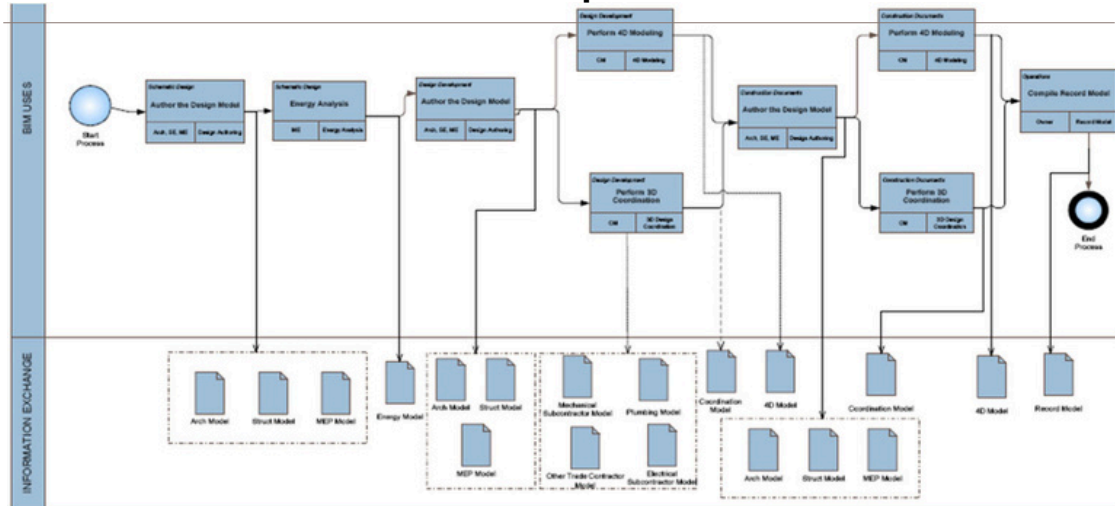
- One created per each BIM Use
- Clearly define the sequence of activities/processes within each Use
- Identify the responsible parties for each activity
- Reference information
- Information exchange among activities

Language used for modeling: **BPMN** (Business Process Modeling Notation)

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STEP2) Design BIM Processes (Example)

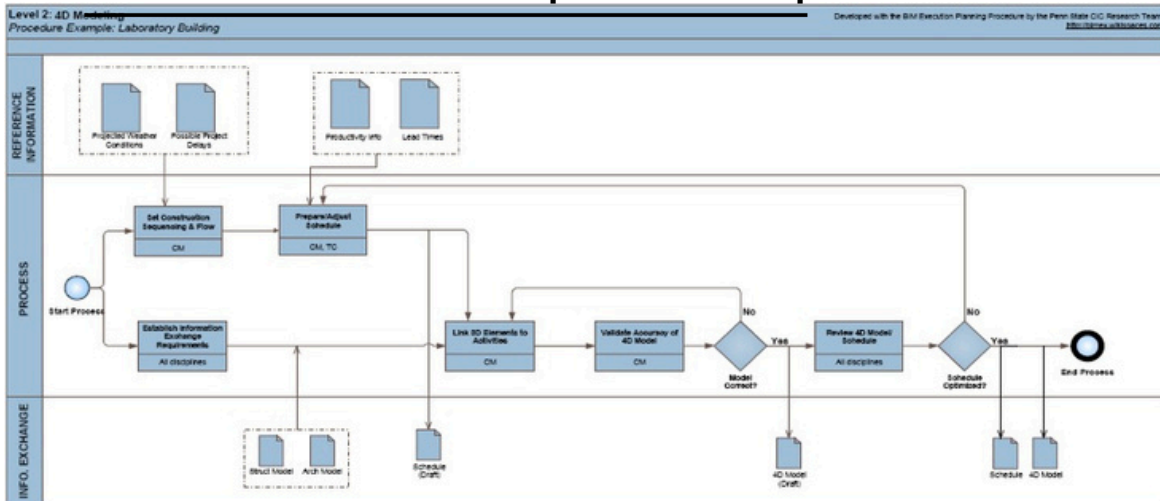
Level 1: BIM Overview Map



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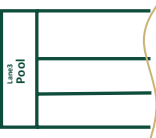
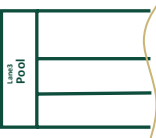
STEP2) Design BIM Processes (Example)










Level 2: Detailed BIM Use processes Map



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STEP2) Design BIM Processes –BPMN

- Event 
- Activity (process) 
- Gateway 
- Sequence Flow 
- Data Object 
- Association 
- Group 
- Pool 
- Lane 

Element	Description	Notation
Event	An Event is an occurrence in the course of a business process. Three types of Events exist, based on when they affect the flow: Start, Intermediate, and End.	
Process	A Process is represented by a rectangle and is a generic term for work or activity that entity performs.	
Gateway	A Gateway is used to control the divergence and convergence of Sequence Flow. A Gateway can also be seen as equivalent to a decision in conventional flowcharting.	
Sequence Flow	A Sequence Flow is used to show the order (predecessors and successors) that activities will be performed in a Process.	
Association	An Association is used to tie information and processes with Data Objects. An arrowhead on the Association indicates a direction of flow, when appropriate.	
Pool	A Pool acts as a graphical container for partitioning a set of activities from other Pools.	
Lane	A Lane is a sub-partition within a Pool and will extend the entire length of the Pool - either vertically or horizontally. Lanes are used to organize and categorize activities.	
Data Object	A Data Object is a mechanism to show how data is required or produced by activities. They are connected to the activities through Associations.	
Group	A group represents a category of information. This type of grouping does not affect the Sequence Flow of the activities within the group. The category name appears on the diagram as the group label. Groups can be used for documentation or analysis purposes.	

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STEP2) Design BIM Processes

Howto design **Level1 MAP** (BIM Overview Map)?

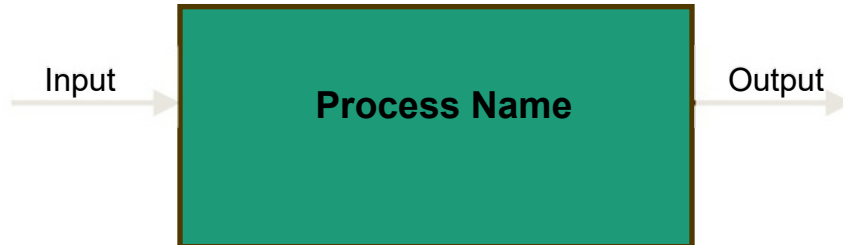
Four sub-steps:

1. **Place** BIM Uses
2. **Arrange** BIMusesaccordingtoproject sequence
3. **Identify responsible parties** foreach process
4. **Determineinformation exchange** required

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STEP2) Design BIM Processes – Level 1

□ SubStep1 –Place BIM Uses



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STEP2) Design BIM Processes – Level 1

□ SubStep1 –Place BIM Uses

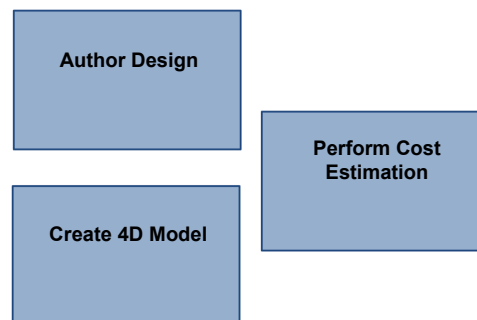
EXAMPLE:

- Goals: To better complete the schematic design, design development, and prepare tender documentations (sequence and cost)

- Phases: SchematicDesign, DesignDevelopment, EarlyConstructionDocuments

○ BIM Uses:

- Design Authoring
- Cost Estimation
- 4D Modeling

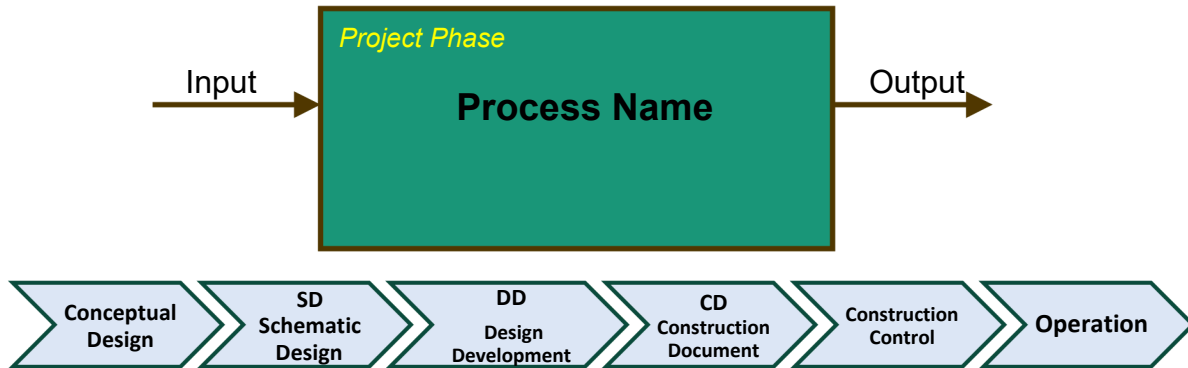


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STEP2) Design BIM Processes – Level 1

□ SubStep2–Arrange BIMUses

At what phase(s) of the project each BIM Use is followed?



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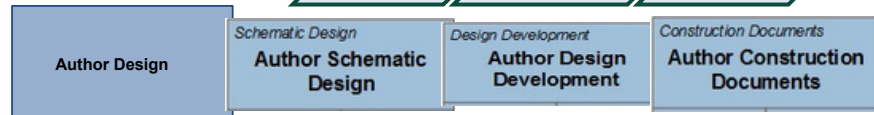
STEP2) Design BIM Processes – Level 1

□ SubStep2 –Arrange BIM Uses (EXAMPLE)

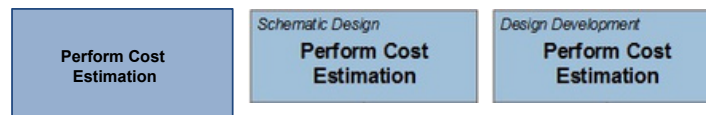
Phases

o BIM Uses:

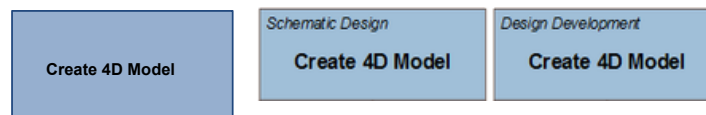
- DesignAuthoring



- Cost Estimation



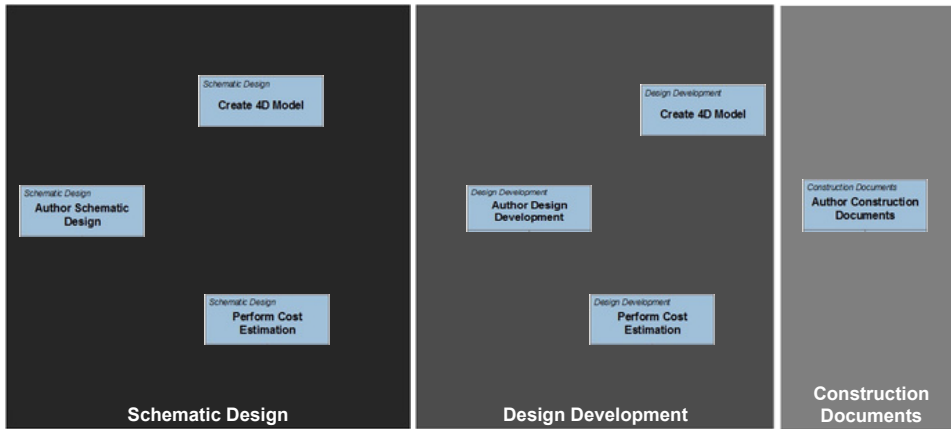
- 4D Modeling



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STEP2) Design BIM Processes – Level 1

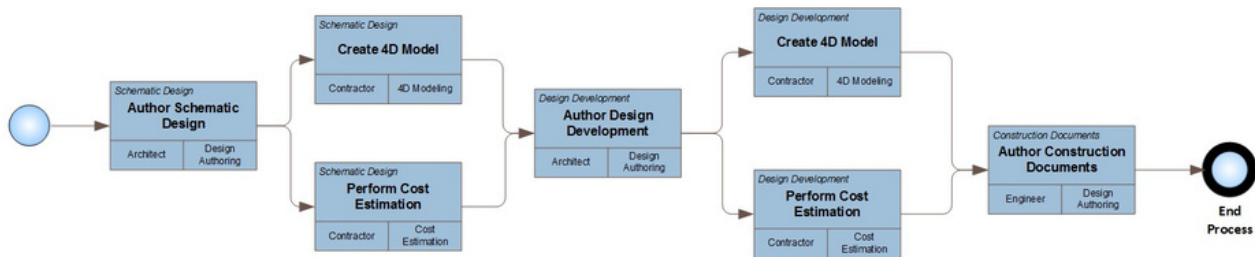
□ SubStep2 –Arrange BIM Uses (EXAMPLE)



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STEP2) Design BIM Processes – Level 1

□ SubStep2 –Arrange BIM Uses (EXAMPLE)



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STEP2) Design BIM Processes – Level 1

SubStep2 Highlights:

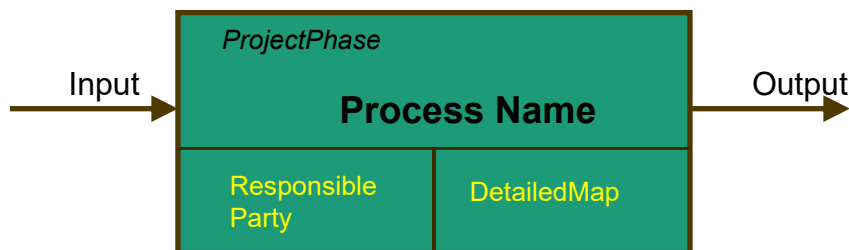
- Map the BIMUses to the **project phases**: Planning, Design (SD, DD, CD), Construction, Operation.
Each BIM Use may be added at **several locations**(if performed
- several times over the project lifecycle).
Level1 Map must provide the team with the **implementation**
- **sequence**.

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STEP2) Design BIM Processes – Level 1

□ SubStep3–Identify Parties

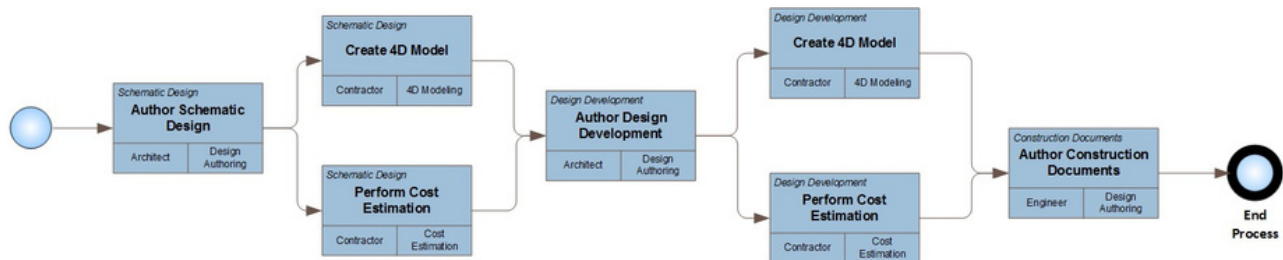
Who is (are) best suited to successfully complete the use?



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STEP2) Design BIM Processes – Level 1

□ SubStep3 –Arrange BIM Uses (EXAMPLE)



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STEP2) Design BIM Processes – Level 1

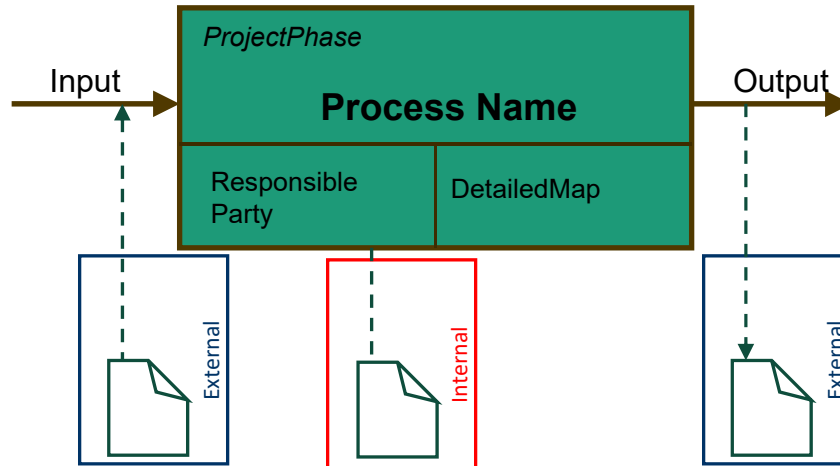
SubStep3 Highlights:

- Forsomecases identifying the responsible party may not be straightforward, or multiple parties might be responsible for a process
- Responsible party is responsible for clearly defining:
 - Information **required** to implement the process
 - Information **produced** by each process
- Each process in the overview map (level1) must direct to the detailed map (level2)

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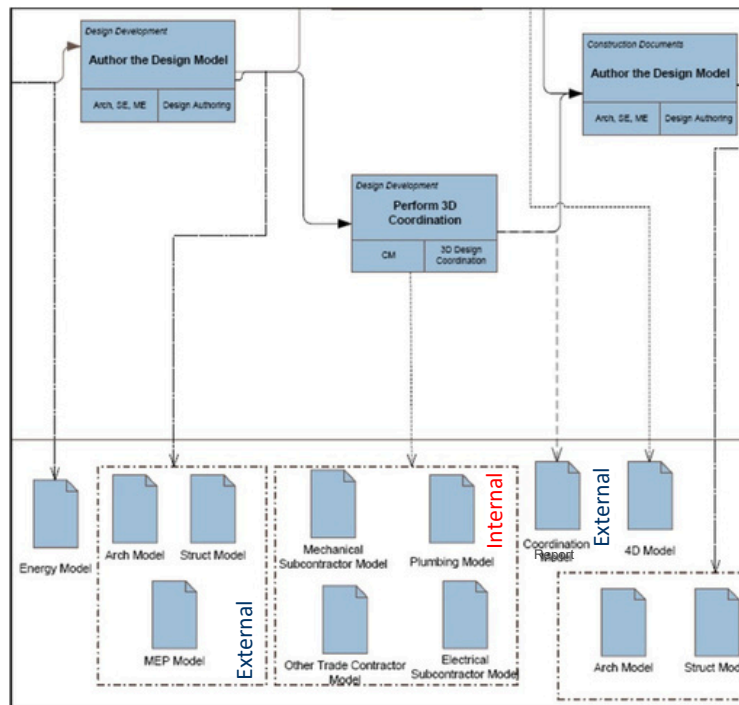
STEP2) Design BIM Processes – Level 1

□ SubStep4 –Determine Information Exchange



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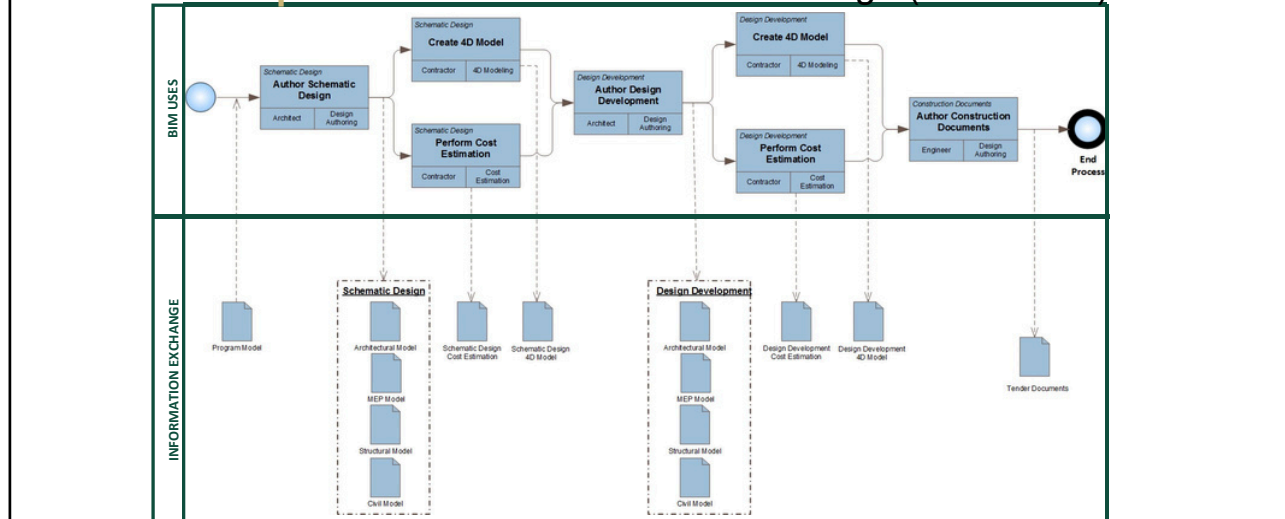
STEP2) Design BIM Processes – Level 1



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STEP2) Design BIM Processes – Level 1

SubStep4 –Determine Information Exchange (EXAMPLE)



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STEP2) Design BIM Processes – Level 1

SubStep4 Highlights :

- Critical Information Exchange
 - Internal (to a particular process) (*yet involving multiple parties*)
 - Shared (among processes &/or parties)
- Normally each information exchange is:
 - Transfer of a data file; or
 - Entry of information into a common database.
- **Groups** represent categories of information.
- We will later explain the details of information exchange procedure.

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STEP2) Design BIM Processes

How to design **Level2 MAPS** (BIM Use Process Maps)?

(Four+1) Steps:

1. **Decompose** BIM Use to a hierarchy of processes;
2. **Define dependencies** between processes;
3. **Develop details** regarding information & parties;
4. Add **Goal Verification Gateways**;

5. Document, review, archive for **future use**.
 - Processes at this level are normally recyclable

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STEP2) Design BIM Processes – Level 2

□ **SubStep1**–Decompose to a hierarchy of processes (tasks)

EXAMPLE: 4D Modeling

Hierarchy:

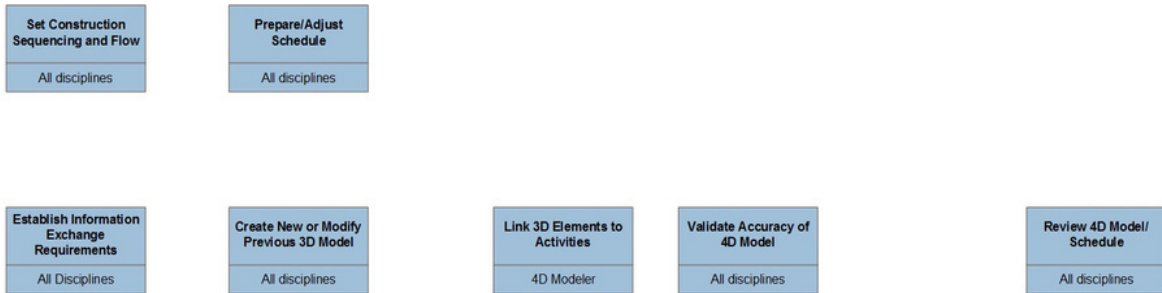
- Sequencing construction activities;
- Prepare Schedule;
- Create/confirm 3D Model;
- Link 3D model to activities;
- Validate 4D schedule;
- Review 4D model.

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STEP2) Design BIM Processes – Level 2

□ **SubStep1** –Decompose to a hierarchy of processes(tasks)

EXAMPLE: 4D Modeling



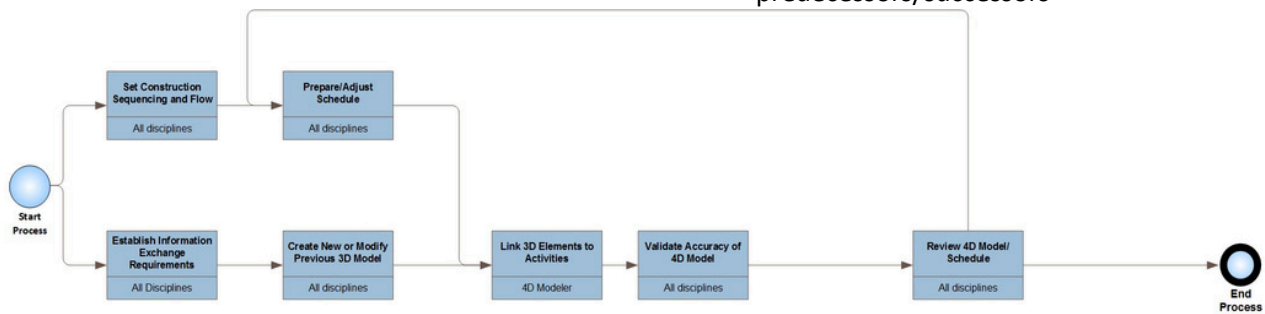
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STEP2) Design BIM Processes – Level 2

□ **SubStep2** –Define Dependencies

EXAMPLE: 4D Modeling

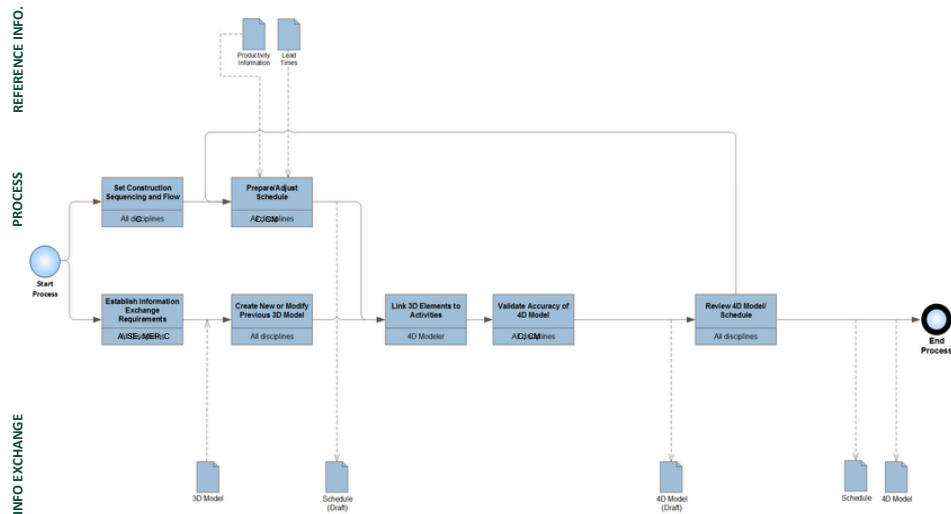
- Connect processes through sequence flow
- Set predecessors
- Set successors
- Sometimes multiple predecessors/successors



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STEP2) Design BIM Processes – Level 2

□ SubStep3 –Details of Information & Parties



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STEP2) Design BIM Processes – Level 2

□ SubStep3 –Details of Information & Parties

Details in level2 maps:

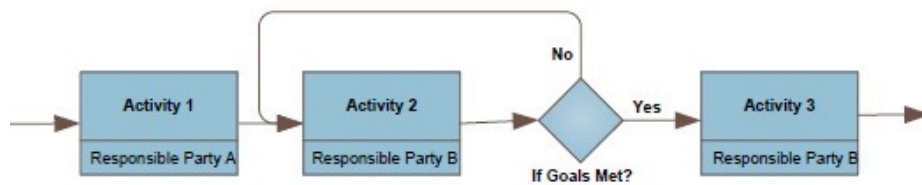
- **Responsible Party** (as before)
- **Information Exchange** (as before –Internal & external information exchanged)
- **Reference Information** (Input Info resources required)

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STEP2) Design BIM Processes – Level 2

□ SubStep4 – Add Goal Verification Gateways

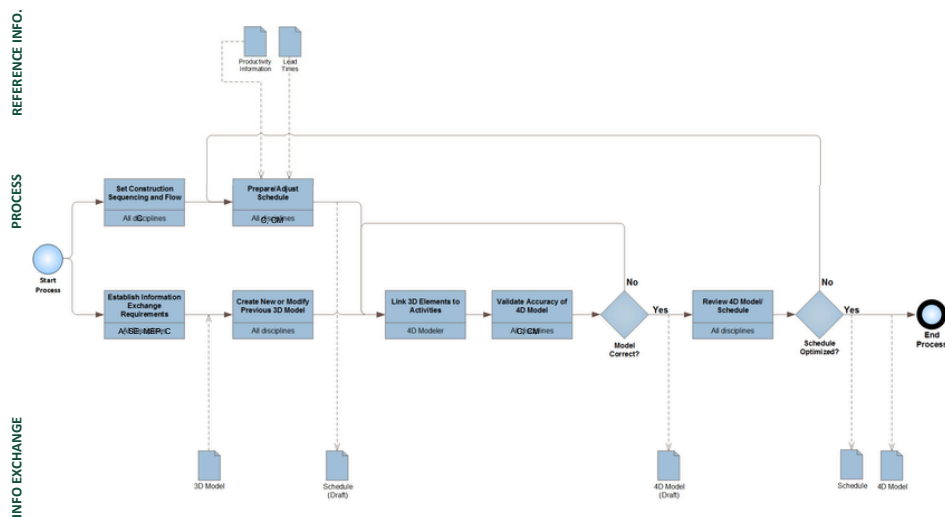
- Use gateways to ensure that deliverables/results meet the requirements
- Gateways help to model decisions & quality control checks before completing a BIM task



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STEP2) Design BIM Processes – Level 2

□ SubStep4 – Add Goal Verification Gateways



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STEP2) Design BIM Processes – SUMMARY

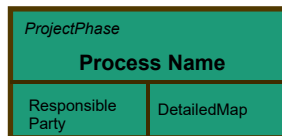
Level1 map

ONE per project

- **TWO-LANE** Processmodel;



- Processes (boxes):



Level2 maps

ONE per BIM Use

- **THREE-LANE** Process models.



- Process (boxes):

