



FOCUS ON THE PROCESS: BIM PROJECT EXECUTION PLANNING

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**ARCHITECTURAL
ENGINEERING**

Virtual Mock-ups

Integrated Systems

Information Standards

Modularization

BIM

Process Design

Experienced-based Design

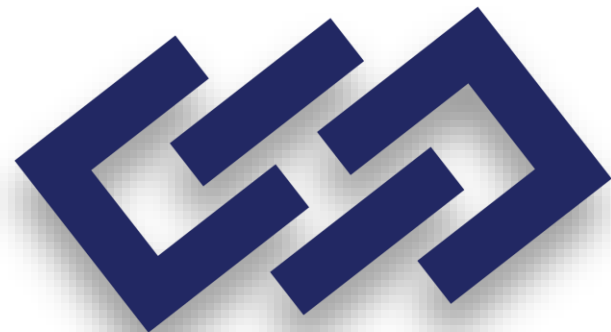
Innovation

Sustainability

High Performance Buildings

Automation

Cloud Computing



PENN STATE
COMPUTER INTEGRATED
CONSTRUCTION

Decision Making

Visualization

Virtual Reality

Team Selection

Integrated Delivery

Serious Games

Lean Construction

Collaboration

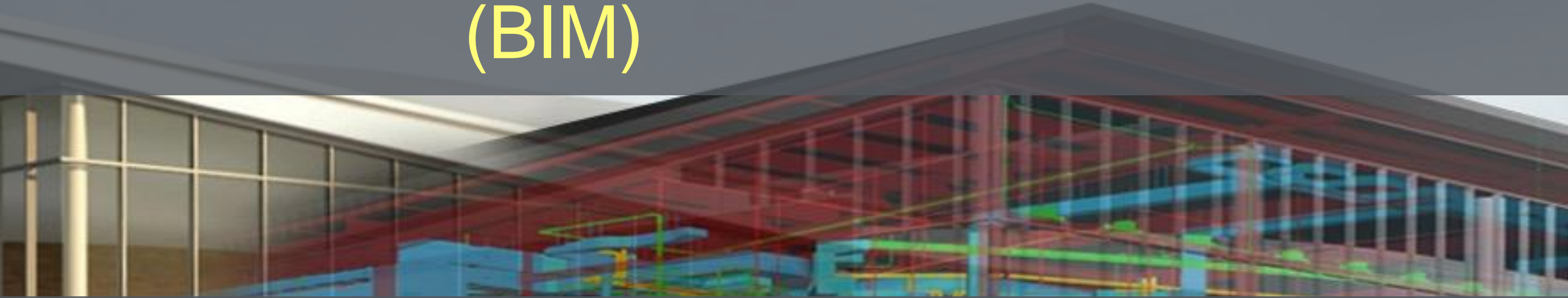
Simulation

Design Pedagogy

Internet of Things

Geographic Information Systems

BUILDING INFORMATION MODELING (BIM)



... a **product** or **intelligent digital representation** of data about a capital facility....

... a **collaborative process** which covers business drivers, automated process capabilities, and open information standards....

... a **facilities lifecycle management** tool....



Source: *National BIM Standard - US, Ver. 1*

BIM

operate.construct.design.plan.

PROJECT EXECUTION PLANNING GUIDE

A buildingSMART alliance™ Project

Sponsored by The Charles Pankow Foundation, The Construction Industry Institute, The Pennsylvania State University Office of Physical Plant, and The Partnership for Achieving Construction Excellence

Developed by the Computer Integrated Construction Research Program at The Pennsylvania State University



BIM Project Execution Planning

BIM Goals
and Uses



Process

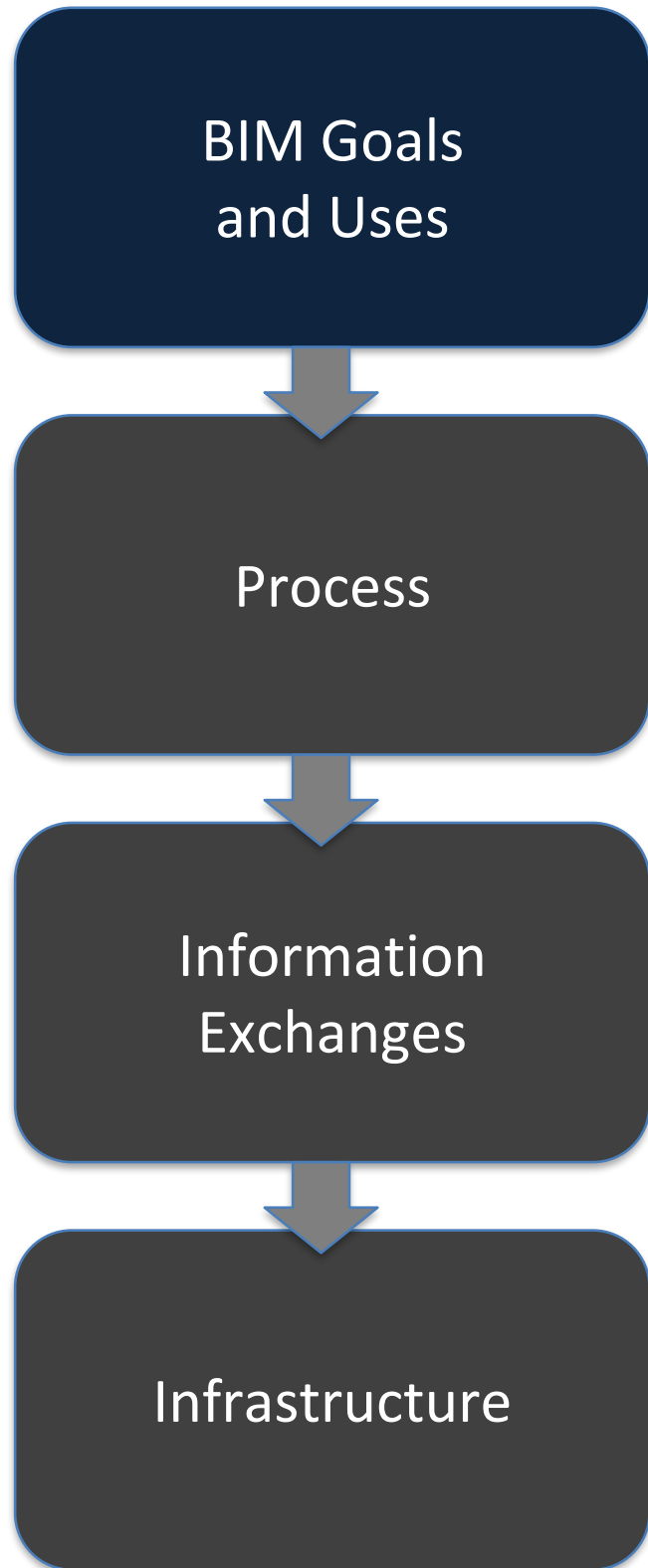


Information
Exchanges



Infrastructure

Identify BIM Goals and 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	
		Structural Analysis	
		Lighting Analysis	
		Energy 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

Phase Planning

Description:
A process in which a 4D model (3D models with the added dimension of time) is utilized to effectively plan the phased occupancy in a renovation, retrofit or addition, or to show the construction sequence and space requirements on a building site. 4D modeling is a powerful visualization and communication tool that can give a project team much better understanding of project milestones and construction plans.

Potential Value:

- Better understanding of the phasing schedule by the owner and project participants and showing the critical path of the project
- Dynamic phasing plans of occupancy offering multiple options and solutions to space conflicts
- Integrate planning of human, equipment and material resources with the BIM model to better schedule and cost estimate the project
- Space and workspace conflicts identified and resolved ahead of the construction process
- Marketing purposes and publicity
- Identification of schedule, sequencing or phasing issues
- More readily constructible, operable and maintainable project (Kang et al., 2007)
- Monitor procurement status of project materials (Kang et al., 2007)
- Increased productivity and decreased waste on job sites (Sheppard, 2004)
- Conveying the spatial complexities of the project, planning information, and support conducting additional analyses (Koo and Fischer, 2000)

Resources Required:

- 3D Model manipulation
- Scheduling software

Team Competencies Required:

- Knowledge of construction scheduling and general construction process. A 4D model is connected to a schedule, and is therefore only as good as the schedule to which it is linked.
- Ability to manipulate, navigate, and review a 3D model.
- Knowledge of 4D software: import geometry, manage links to schedules, produce and control animations, etc.

Selected Resources:

- Dawood, N., and Maitlis, Z. (2006). Construction Workplace Planning: Assignment and Analysis Utilizing 4D Visualization Technologies. *Computer-Aided Civil and Infrastructure Engineering*, Pgs. 498-513.
- Jongeling, R., Kim, J., Fischer, M., Morgeous, C., and Olofsson, T. (2008). Quantitative analysis of workflow, temporary structure usage, and productivity using 4D models. *Automation in Construction*, Pgs. 750-751.
- Kang, J. H., Anderson, S. D., and Clayton, M. J. (2007). Empirical Study on the Merit of Web-based 4D Visualization in Collaborative Construction Planning and Scheduling. *Journal of Construction Engineering and Management*, Pgs. 447-461.

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 Facility Manager Designer	MEP HIGH MED	2 2 2 1 2 1 3 3 3	Requires training and software		YES
Cost Estimation	MED	Contractor	HIGH	2 1 1			NO
4D Modeling	HIGH	Contractor	HIGH	3 2 2	Need training on latest software Infrastructure needs	High value to owner due to phasing complications Use for Phasing & Construction	YES
3D Coordination (Construction)	HIGH	Contractor Subcontractors Designer	HIGH HIGH MED	2 3 3 3 3 3 2 3 3	Conversion to Digital Fabrication required	Modeling learning curve possible	YES
Engineering Analysis	HIGH	MEP Engineer Architect	HIGH MED	2 2 2 2 2 2			MAYBE
Design Reviews	MED	Arch	LOW	1 2 1		Reviews to be from design model no additional detail required	NO
3D Coordination (Design)	HIGH	Architect MEP Engineer Structural Engineer	HIGH MED HIGH	2 2 2 2 2 1 2 2 1	Coordination software required	Contractor to facilitate Coord.	YES
Design Authoring	HIGH	Architect MEP Engineer Structural Engineer Civil Engineer	HIGH MED HIGH LOW	3 3 3 3 3 3 3 3 3 2 1 1	Large learning curve	Civil not required	YES
Programming	MED					Planning Phase Complete	NO

* Additional BIM Uses as well as information on each Use can be found at <http://www.engr.psu.edu/ae/cic/bimex/>

"Begin with the end in mind."



Primary

Gather

Generate

Analyze

Communicate

Realize

secondary

Quality	Monitor
Capture	Quantify

Prescribe	Size
Arrange	

Coordinate	Forecast
Validate	

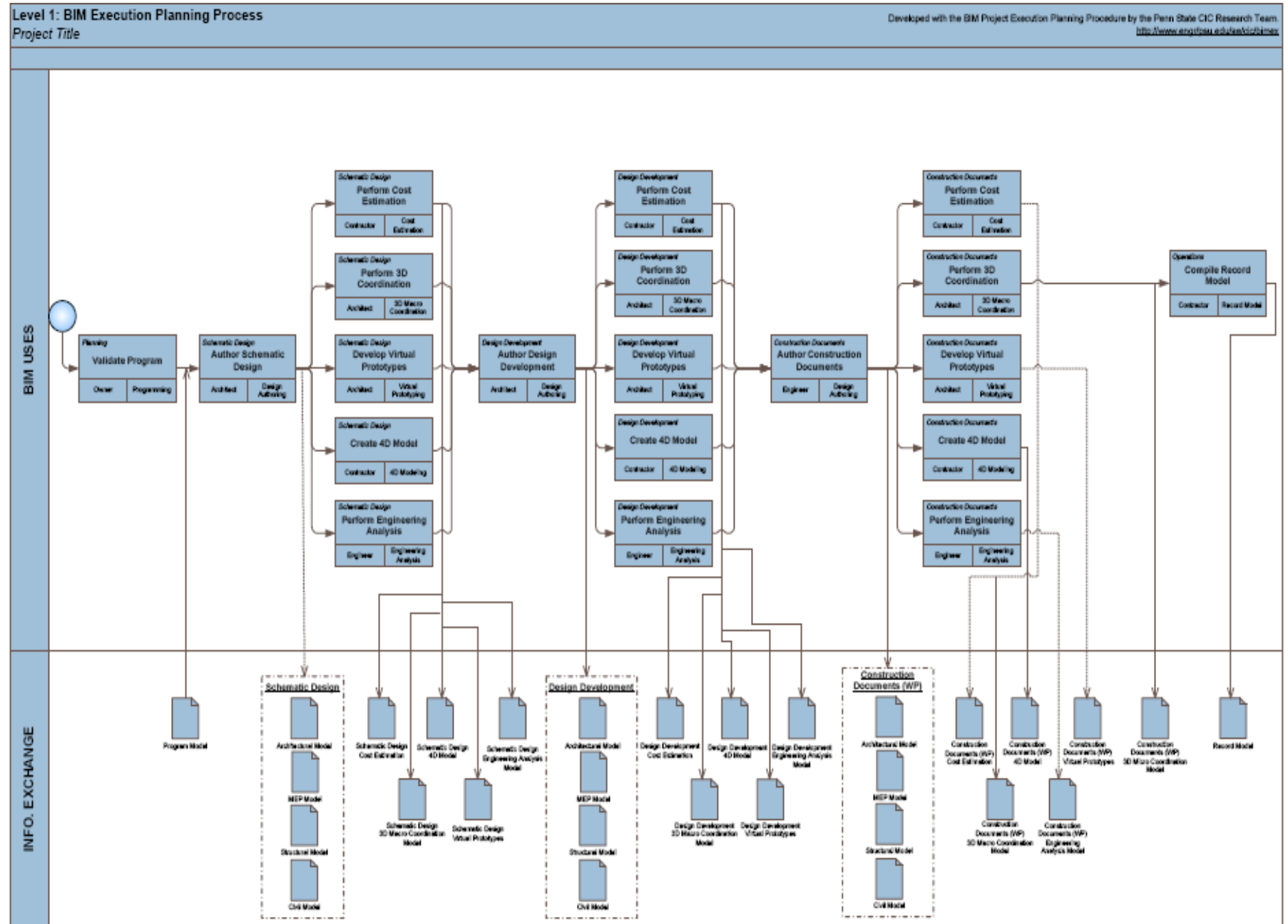
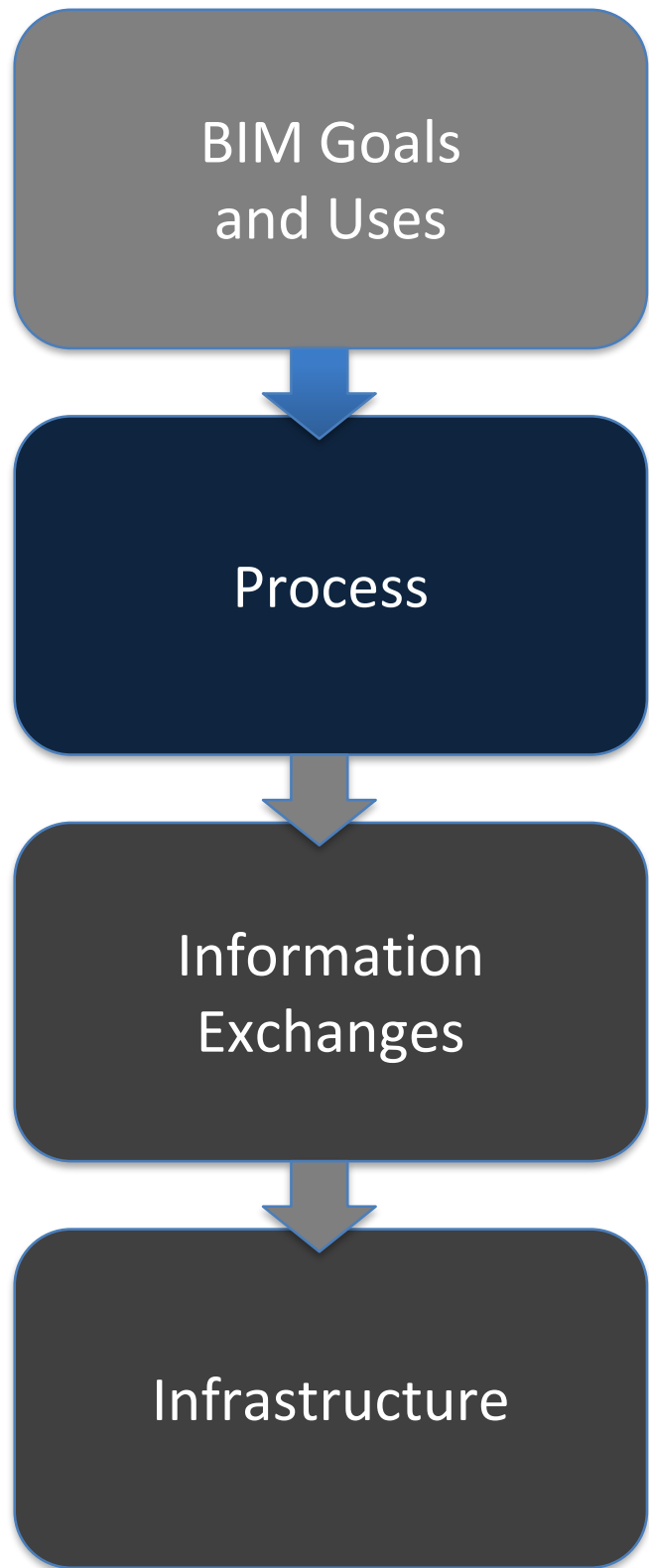
Visualize	Draw
Transform	Document

Fabricate	Assemble
Control	Regulate

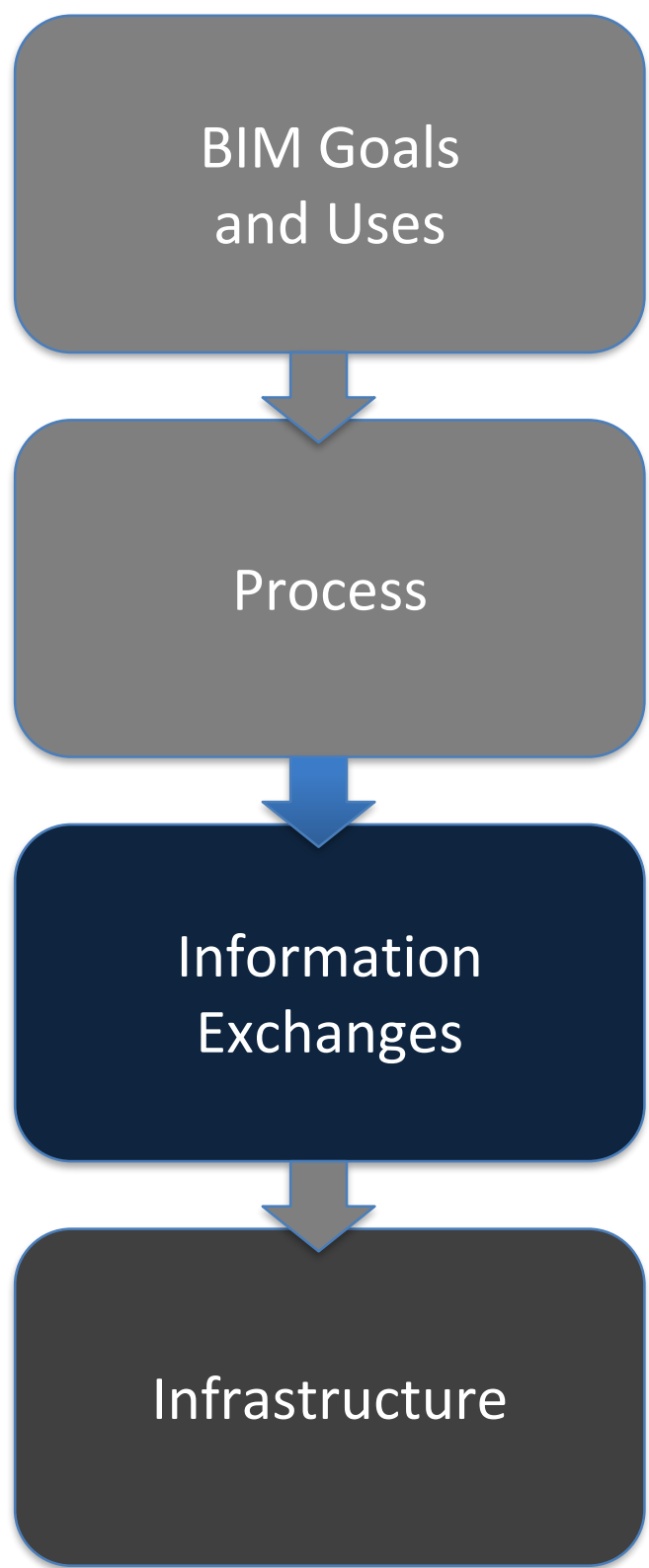


Primary and Secondary Purposes for BIM

Design the BIM Process



Define Information Exchanges



Information		Responsible Party	
A	Accurate Size & Location, include materials and object parameters	A	Architect
B	General Size & Location, include parameter data	C	Contractor
C	Schematic Size & Location	CV	Civil Engineer
		FM	Facility Manager
		MEP	MEP Engineer
		SE	Structural Engineer
		TC	Trade Contractors

Information Exchange Title		Design Authoring	
		OUTPUT	
Time of Exchange (SD, DD, CD, Construction)		N/A	
Model Receiver			
Receiver File Format			
Application & Version			
Model Element Breakdown		Info	Resp Party
B	SHELL		
	Superstructure		
	Floor Construction	B	A
	Roof Construction	B	A
	Exterior Enclosure		
	Exterior Walls	B	A
	Exterior Windows	B	A
	Exterior Doors	B	A
	Roofing		
	Roof Coverings	B	A
	Roof Openings	B	A
C	INTERIORS		
	Interior Construction		
	Partitions	B	A
	Interior Doors	B	A
	Fittings	B	A
	Stairs		
	Stair Construction	B	A
	Stair Finishes		
	Interior Finishes		
	Wall Finishes		
	Floor Finishes		
	Ceiling Finishes		
D	SERVICES		

2016 LEVEL OF DEVELOPMENT SPECIFICATION October 19, 2016 **BIMFORUM**

Milestones/Deliverables

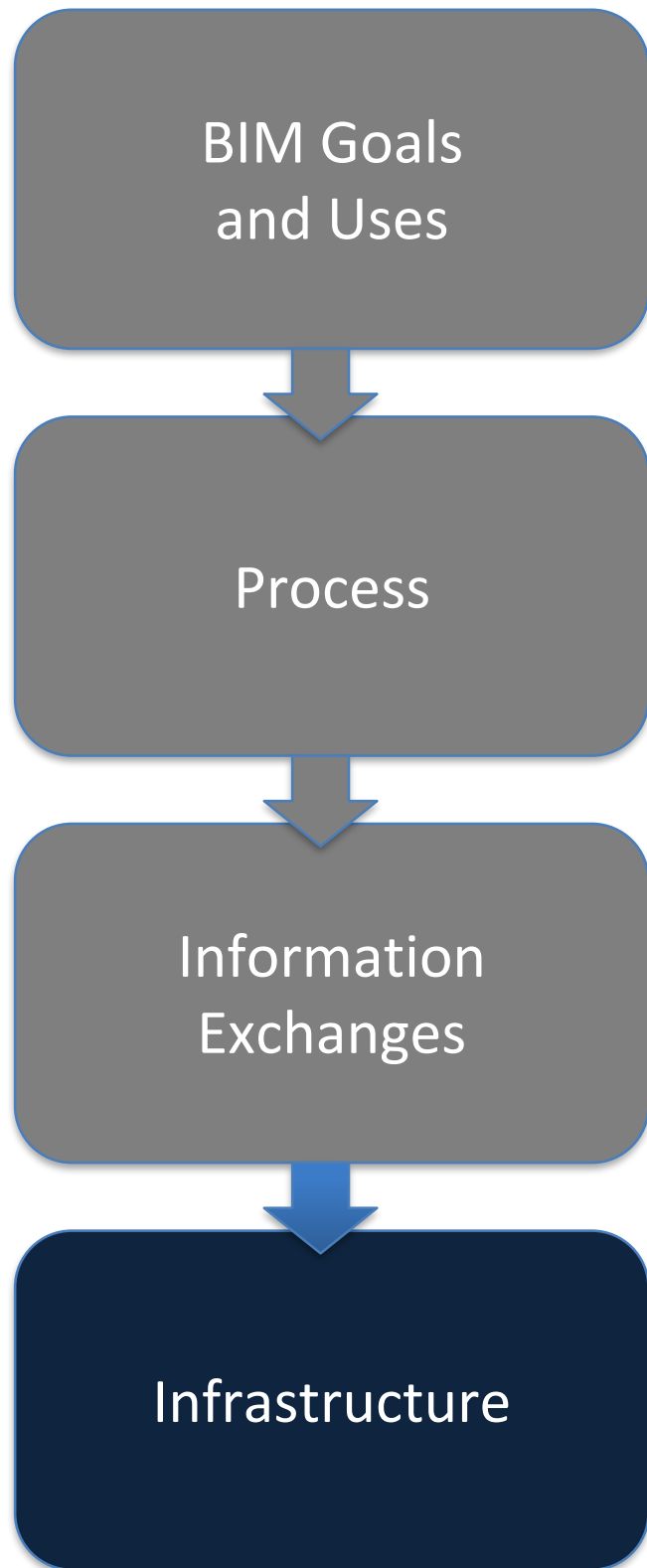
Model Elements	SD	DD	CD	Construction	Facilitation
Building Systems					

PARTICIPATING ORGANIZATIONS

- The American Institute of Architects
- AGC of America
- ASCE
- BSA
- PCI Concrete Institute
- USIBD

	B	A			B	A	
					C	A	
						A	
					B	A	Reflectance
					B	A	Reflectance
					B	A	Reflectance

Develop Supporting Infrastructure



**BIM PROJECT EXECUTION PLAN
VERSION 2.0
FOR
[PROJECT TITLE]
DEVELOPED BY
[AUTHOR COMPANY]**

This template is a tool that is provided to assist in the development of a BIM project execution plan as required per contract. The template plan was 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. The bSa project is sponsored by The Charles Pankow Foundation (<http://www.pankowfoundation.org>), Construction Industry Institute (CII) (<http://www.construction-institute.org>), Penn State Office of Physical Plant (OPP) (<http://www.opp.psu.edu>), and The Partnership for Achieving Construction Excellence (PACE) (<http://www.engr.psu.edu/pace>). The BIM Project Execution Planning Guide can be downloaded at <http://www.engr.psu.edu/BIM/PxP>.

This coversheet can be replaced by a company specific coversheet that includes at a minimum document title, project title, project location, author company, and project number.

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SECTION D: PROJECT GOALS / BIM USES

Describe how the BIM Model and Facility Data are leveraged to maximize project value (e.g. design alternatives, life-cycle analysis, scheduling, estimating, material selection, pre-fabrication opportunities, site placement, etc.) Reference www.engr.psu.edu/bim/download for BIM Goal & Use Analysis Worksheet.

1. MAJOR BIM GOALS / OBJECTIVES:
State Major BIM Goals and Objectives

PRIORITY (High/ Med/ Low)	GOAL DESCRIPTION	POTENTIAL BIM USES

2. BIM USE ANALYSIS WORKSHEET: ATTACHMENT 1
Reference www.engr.psu.edu/bim/download for BIM Goal & Use Analysis Worksheet. Attach BIM Use analysis Worksheet as Attachment 1.

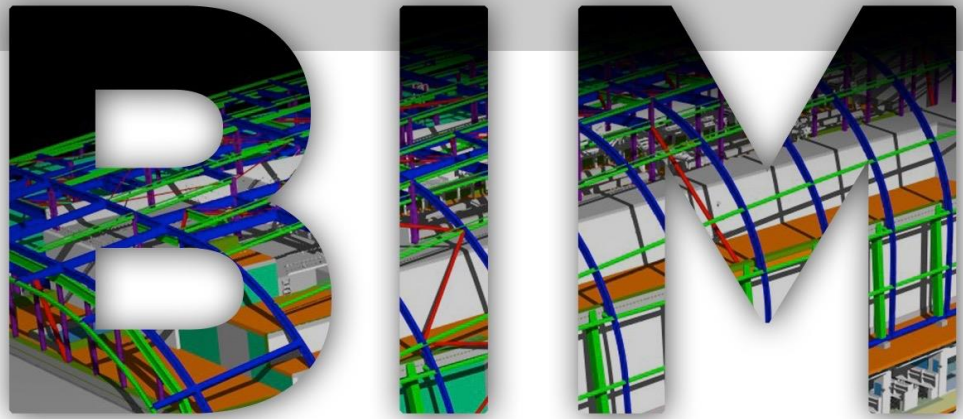
3. BIM USES:
Highlight and place an X next to the additional BIM Uses as selected by the project team using the BIM Goal & Use Analysis Worksheet. See BIM Project Execution Planning Guide at www.engr.psu.edu/BIM/BIM_Uses for Use descriptions. Include additional BIM Uses as applicable in empty cells.

X	PLAN	X	DESIGN	X	CONSTRUCT	X	OPERATE
	PROGRAMMING		DESIGN AUTHORIZING		SITE UTILIZATION PLANNING		BUILDING MAINTENANCE SCHEDULING
	SITE ANALYSIS		DESIGN REVIEWS		CONSTRUCTION SYSTEM DESIGN		BUILDING SYSTEM ANALYSIS
			3D COORDINATION		3D COORDINATION		ASSET MANAGEMENT
			STRUCTURAL ANALYSIS		DIGITAL FABRICATION		SPACE MANAGEMENT / TRACKING
			LIGHTING ANALYSIS		3D CONTROL AND PLANNING		DISASTER PLANNING
			ENERGY ANALYSIS		RECORD MODELING		RECORD MODELING
			MECHANICAL ANALYSIS				
			OTHER ENG. ANALYSIS				
			SUSTAINABILITY (LEED) EVALUATION				
			CODE VALIDATION				
	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)
	COST ESTIMATION		COST ESTIMATION		COST ESTIMATION		COST ESTIMATION
	EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING

Begin with the End in Mind.

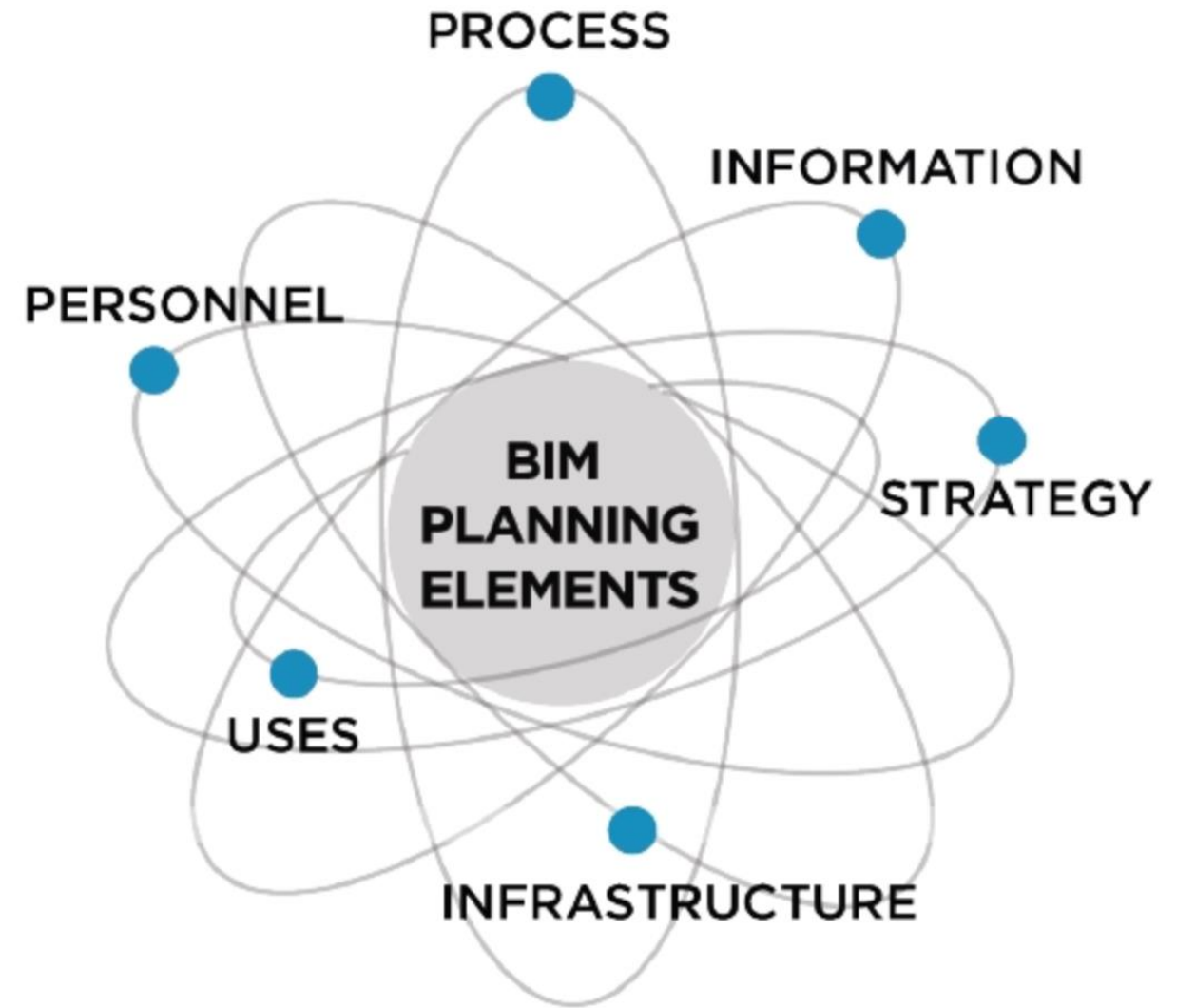


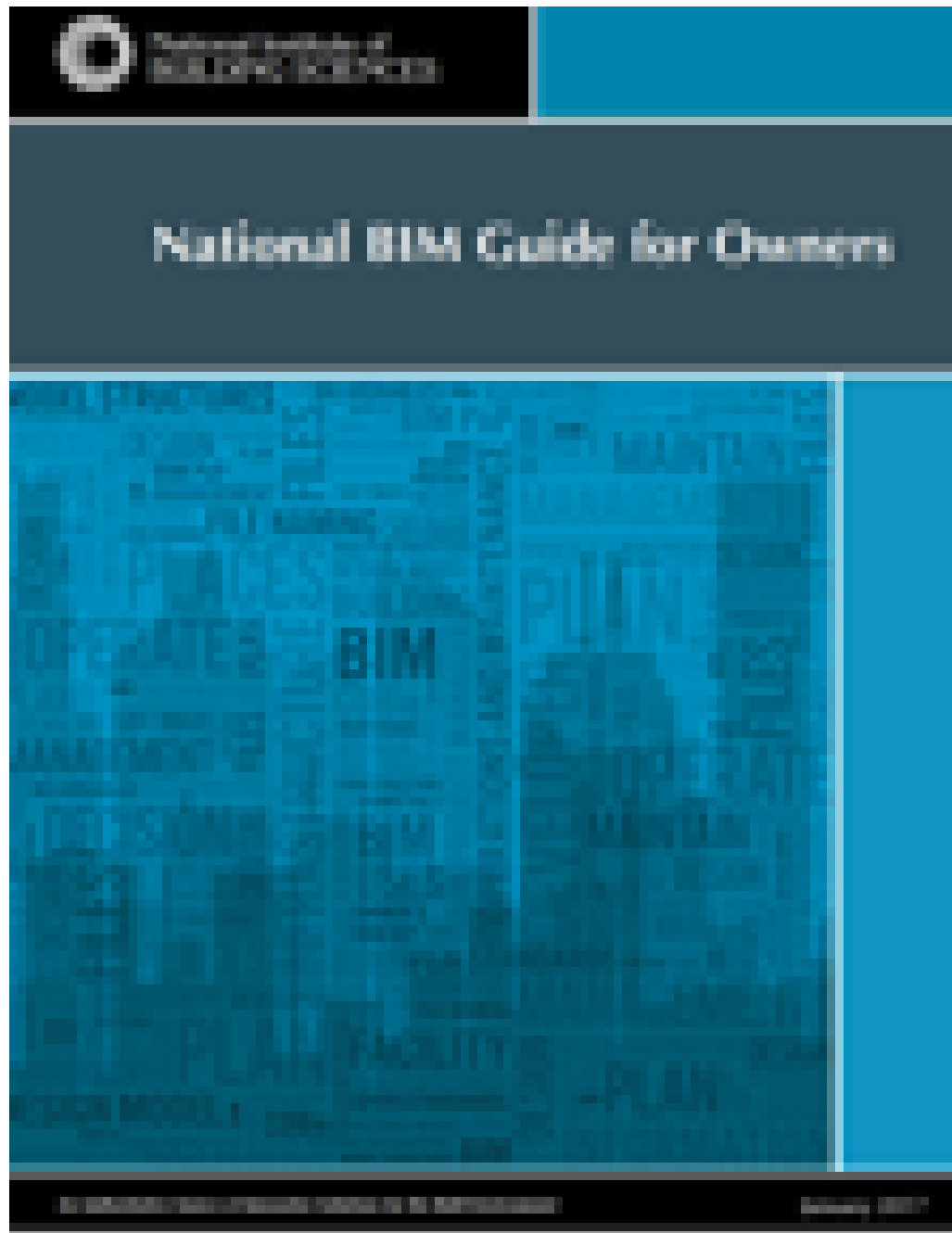
BUILDING INFORMATION MODELING



PLANNING GUIDE FOR FACILITY OWNERS

A BUILDING SMART™ ALLIANCE PROJECT
VERSION 2.0 FEBURARY 2013
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Contents

Process for Implementation

- Defining BIM Requirements
- Team Roles & Responsibilities
- BIM Planning
- Managing Requirements & Deliverables

Infrastructure & Standards

BIM Execution

- BIM Planning requirement
- Identifying Essential BIM Uses
 - Existing Condition Modeling
 - Design Authoring
 - Design Review
 - Coordination
 - Record Modeling

What is Important?



Advanced
Research
Initiatives



Pilot
Implementation
Projects



Simple
Standard
Practices

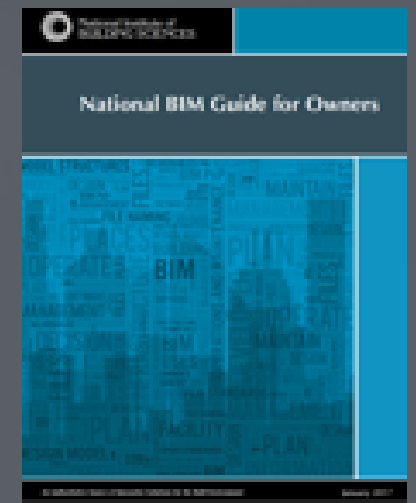
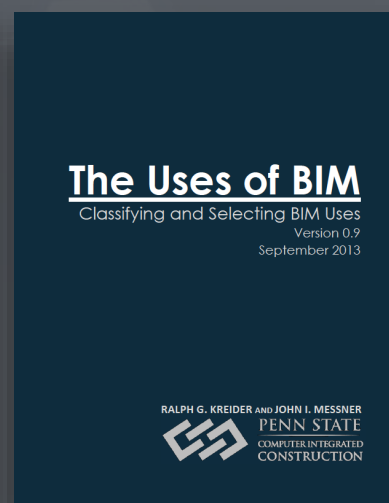
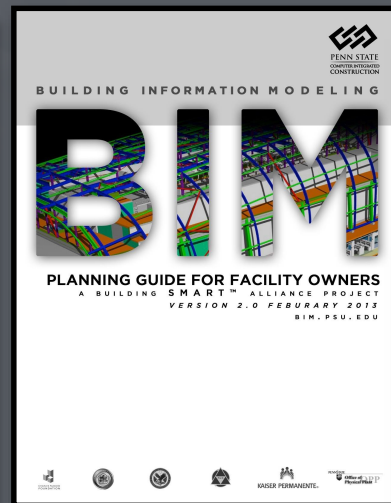
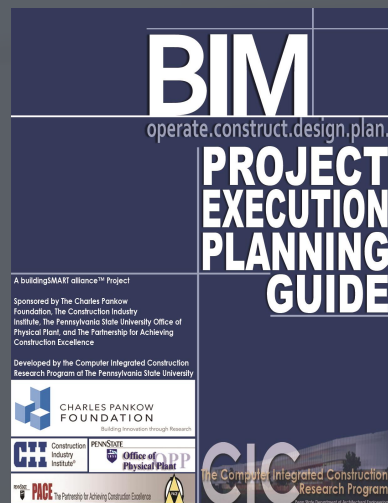


Education
and
Training

Focus on the Goal

Implement easy to adopt **standard approaches** for high value BIM uses,
with **well trained experts**,
while continuing to **research, develop and test new approaches** in the lab and on pilot projects.

Danke!



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WWW.NIBS.ORG/?N BGO



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