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# National Institute of Building Sciences

Provider Number: G168

Rethinking 7 Misconceptions about Interoperability

**BI17TH1B**

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**12 January, 2017**





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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.





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# Learning Objectives

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At the end of the this course, participants will be able to:

1. Gain a strategic insight into the current industry trends in interoperability and how they affect practical data flow between members of the design / construction team to improve building performance.
2. Explore the reasons behind why BIM projects and methods can disappoint and frustrate new users. Could it be because users have unrealistic expectations of BIM methods and results?



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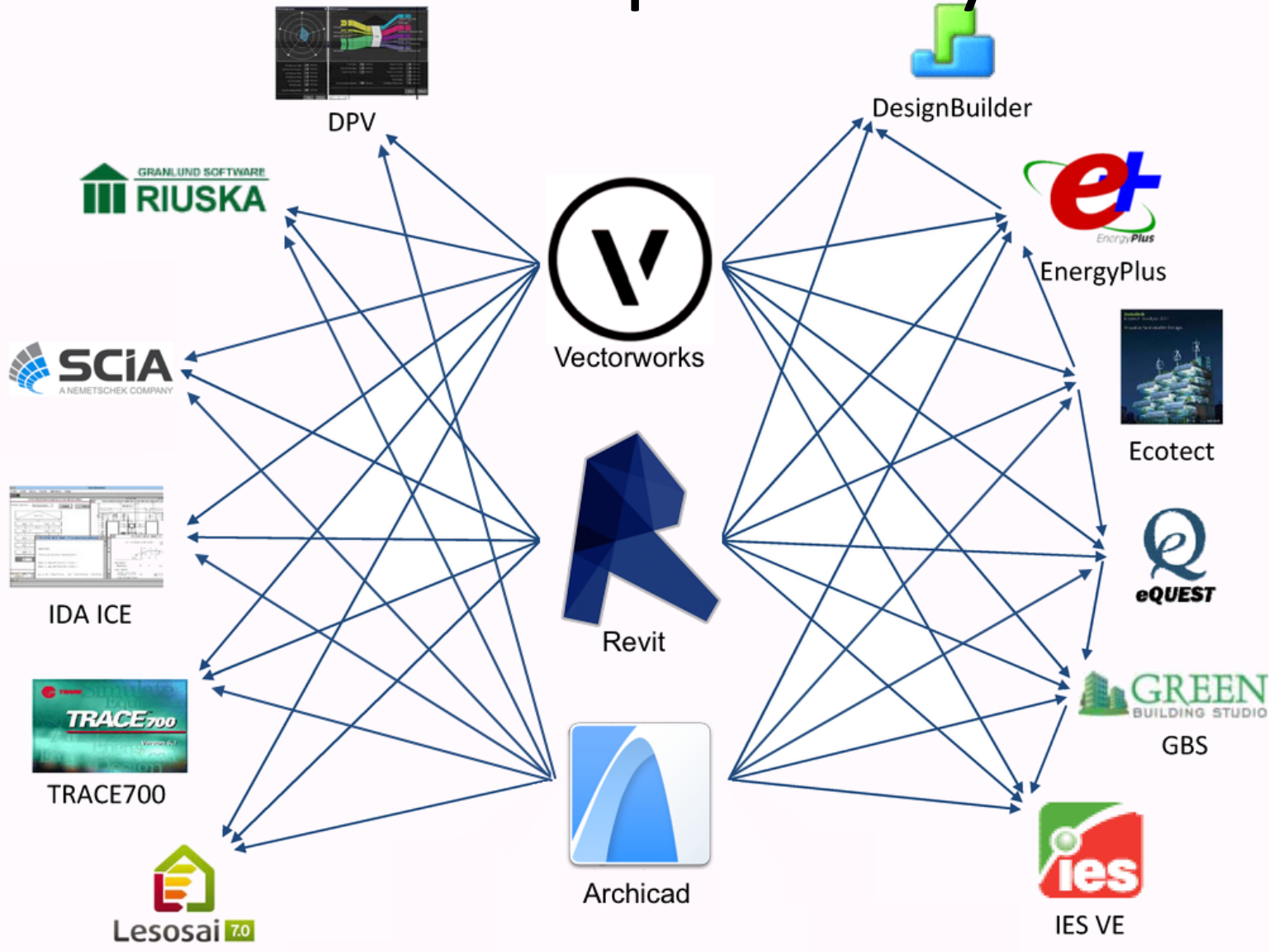
## Topics

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1. Why do we need interoperability?
2. Why is interoperability hard?
3. Why doesn't IFC work?
4. Metaphors: is BIM a planet?
5. The 5 BIMs
6. What Interoperability Looks like Today
7. The Big Picture



# Why do we need Interoperability?



Because (1): No single software does it all



# Because (2): Vertical vs. Horizontal

Vertical	Horizontal
Ability to dictate the component parts of the solution stack and all of the value-add improvements	All dependent on how the other components play their part
When the end product is better, the company gets a higher benefit from the success of the product (Apple's thinking)	Can benefit from the success of everyone in the value chain
Within the company's four walls	Requires frequent collaboration. Lack of trust will kill the model.
Efficiency	Flexibility over maximum efficiency
Higher risk and exposure to disruption	Lower level of mitigated risk if you optimize your network
Higher capital requirements to create, produce and distribute products.	Lower capital required, allows others to hold assets in production, distribution, etc.
What they achieve detracts from the entire value chain	Helping your partners, helps you.

### Level of Control



### Leverage



### Collaboration



### Focus



### Level of Risk



### Capital Requirements



### Attitude Towards Partners



# Why do we need Interoperability?



Because (3):  
Demand  
from Users

THE BUSINESS VALUE OF BIM FOR INFRASTRUCTURE DATA

## Where H

### What Would Most Improve Information Mobility

Percentage of respondents who rated each improvement factor as high or very high

When current use  
where 1  
implem  
numbe  
finding  
educati  
accepte  
active i  
associa  
Seve  
importa

#### MOST DEMANDED IMPROVEMENTS



**76% demanded**  
Improved devices for use at project sites



**75% demanded**  
More reliable or ubiquitous connectivity and bandwidth



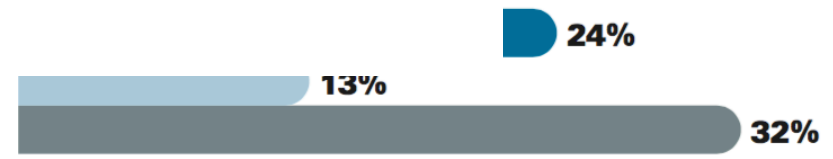
**71% demanded**  
More standardization and interoperability of data platforms

- The ne  
intero  
all pla
- Challe
- that involves BIM
- proportions of th
- opportunity for i
- held need.

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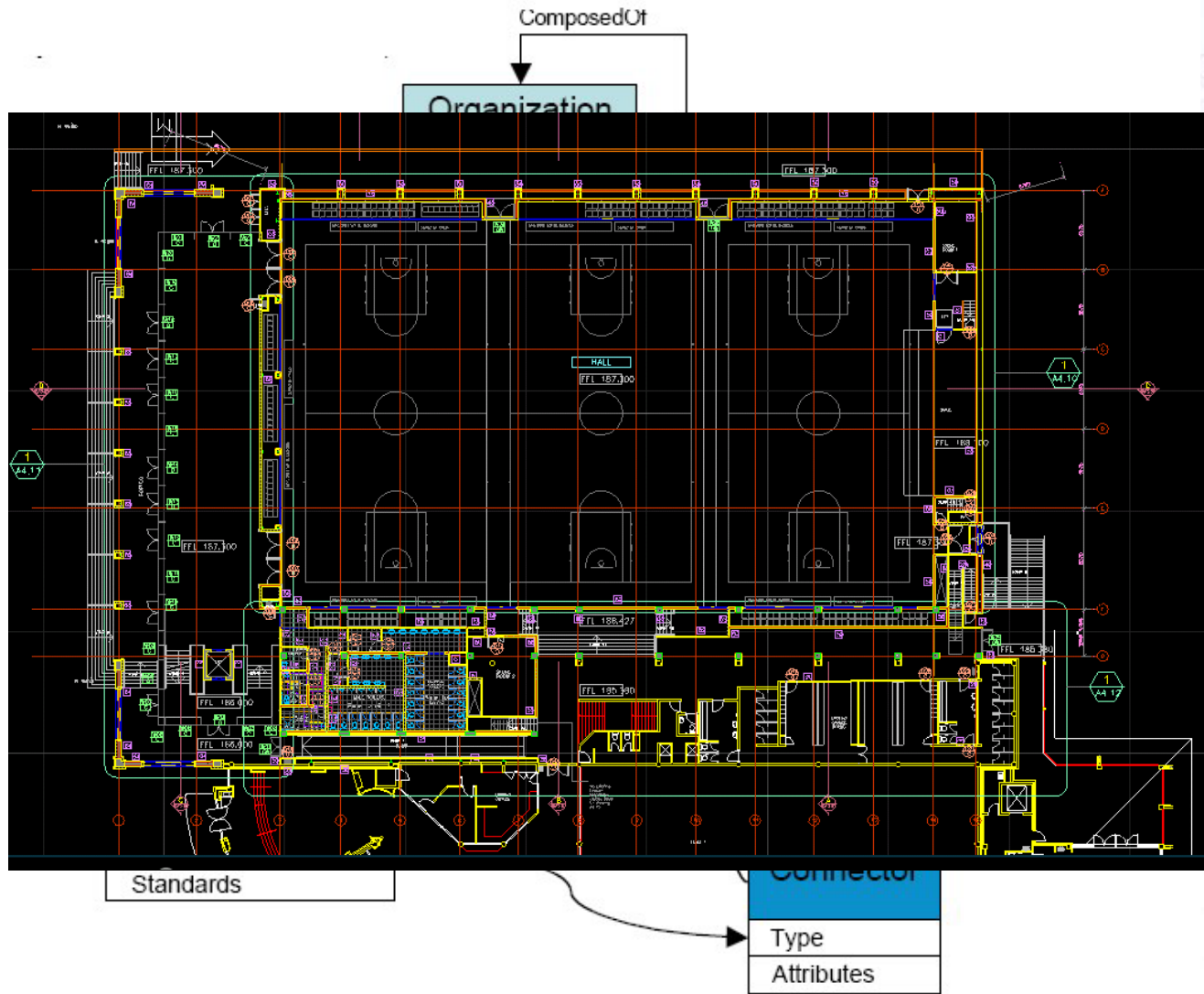
SmartMarket Brief: BIM Advancements

- Mobile Apps for Communication
- BIM Functionality in the Cloud





# Why is Interoperability Hard?



- CAD

- Geometry

- 2D, some 3D

- Some data (Attribute-value pairs)

- BIM

- Geometry

- 3D / 2D integrated

- LOTS of data

- Dimensions / Parameters
    - Properties

- **Semantics / Ontology**

# Why doesn't IFC work? Mismatches...

## User Expectations:

- Native-to-Native Object Communication
- Owner expectations of Natively Editable files
- One Complete Model

## Reality

- Reference Workflows
- Complete Model in Aggregation
- Arcane, poorly understood workflows





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# But is it really true that IFC doesn't work?

## Autodesk 2016 products that support IFC



### A360

A360 enables design, engineering and project teams to work together efficiently on one central platform.



### Advance Steel

Advance Steel detailing software helps accelerate design, steel detailing, steel fabrication, and steel construction.



### AutoCAD Architecture

AutoCAD Architecture software is an architectural drafting tool to help you design and document more efficiently.



### AutoCAD MEP

AutoCAD MEP software helps you draft, design, and document building systems.



### AutoCAD Civil 3D

Use AutoCAD Civil 3D civil engineering design and documentation software to support BIM workflows.



### BIM 360 Glue

BIM 360 Glue is a cloud-based BIM management and collaboration product that connects your entire project team.



### Fabrication CADmep

Fabrication CADmep mechanical detailing software supports fabrication workflows for MEP contractors.



### Fabrication ESTmep

Fabrication EST cost estimation software can help MEP contractors gain a better understanding of real project costs.



### InfraWorks

Use InfraWorks 360 software to plan, design, and engineer with real data, in the real world, in real time.



### Inventor Professional

Inventor® software offers professional-grade 3D mechanical design, documentation, and product simulation tools.



### Navisworks

Navisworks project review software products enables AEC professionals to holistically review integrated models and data.



### Revit

Design, construct, and maintain higher-quality, more energy-efficient buildings with Revit software, built specifically for BIM.



### Revit LT

Revit LT software is a 3D BIM tool that helps you produce high-quality 3D architectural designs and documentation.



### Robot Structural Analysis

Robot Structural Analysis software provides engineers with advanced BIM-integrated analysis and design tools.



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# IFC4 and Rising to User Expectations





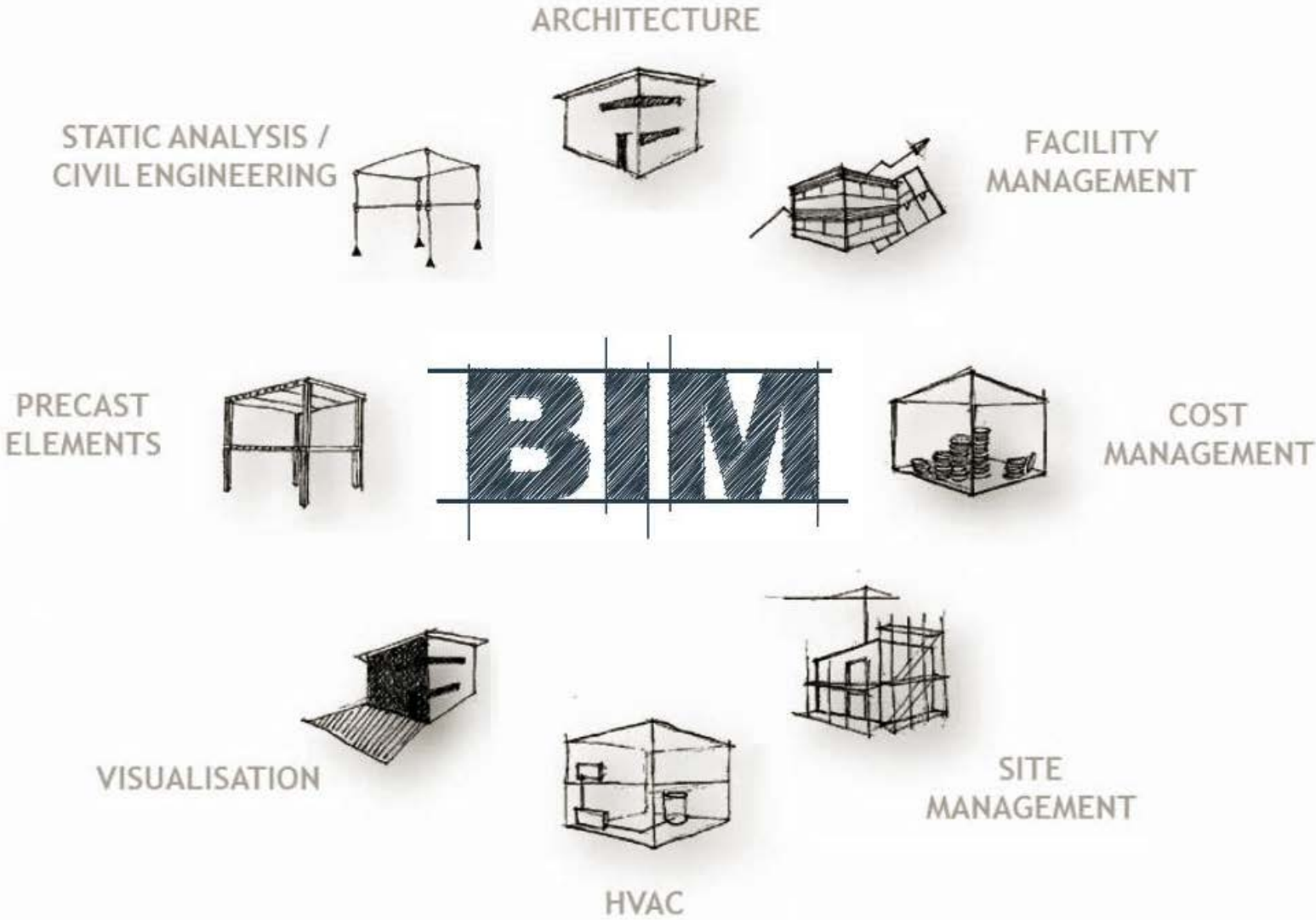
## 2 — BIM Metaphors

# PLANET as a Metaphor for BIM

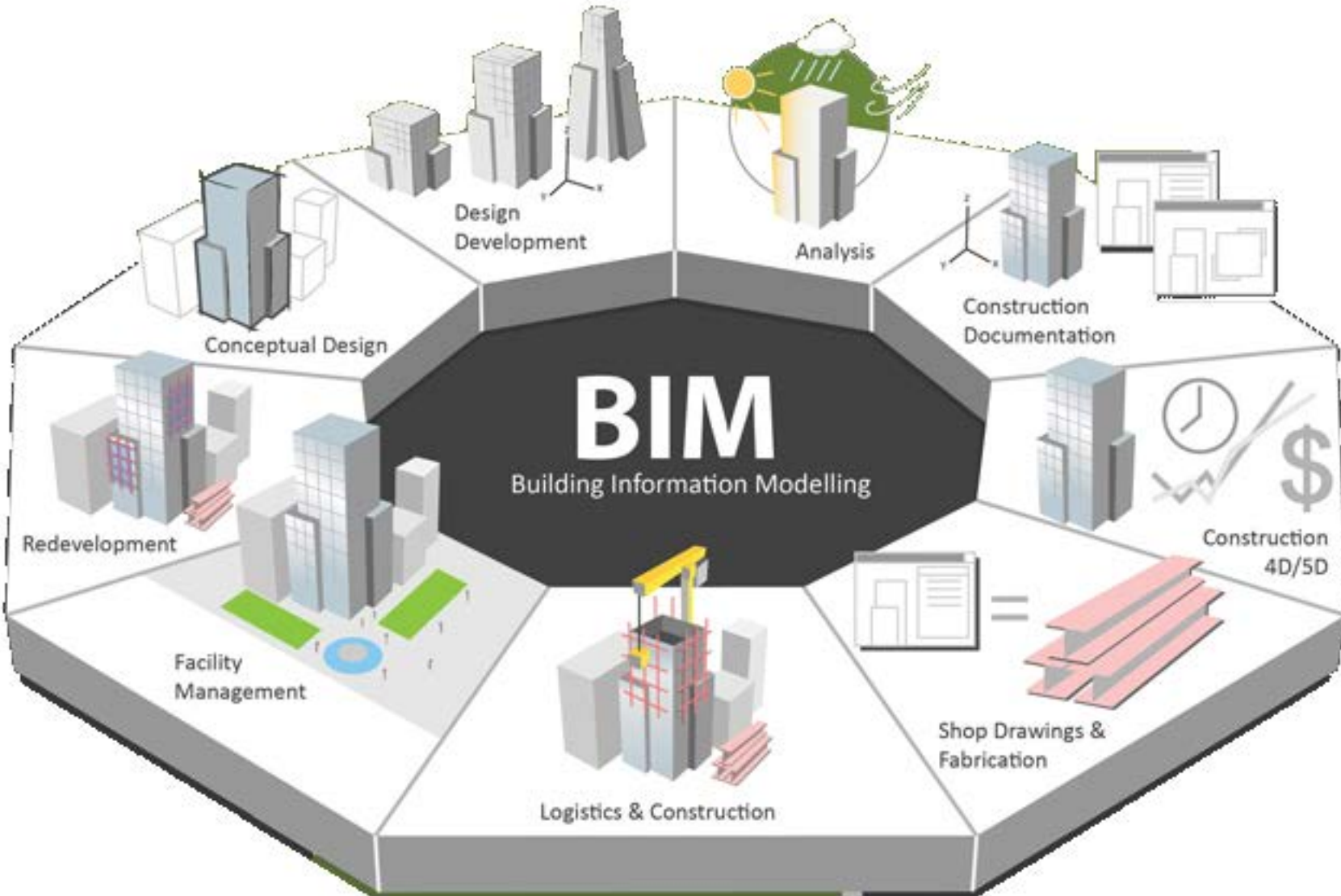


“Blue Marble”— Apollo 17—December 1972

# BIM AS PLANET — WITH TEAM AS SATELLITES



# BIM AS PLANET — WITH LIFECYCLE AS SATELLITES



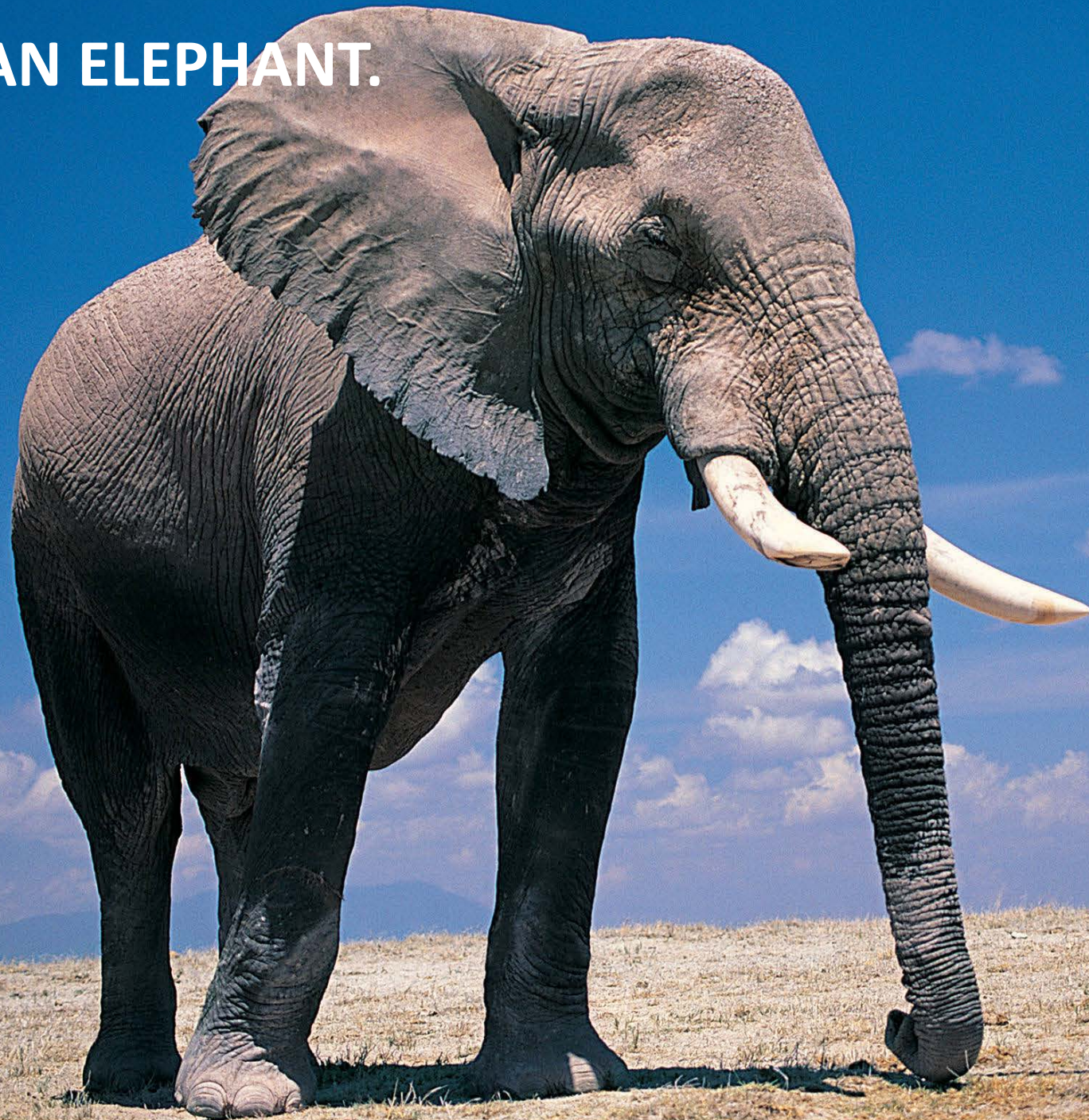


**BIM IS NOT A PLANET...**



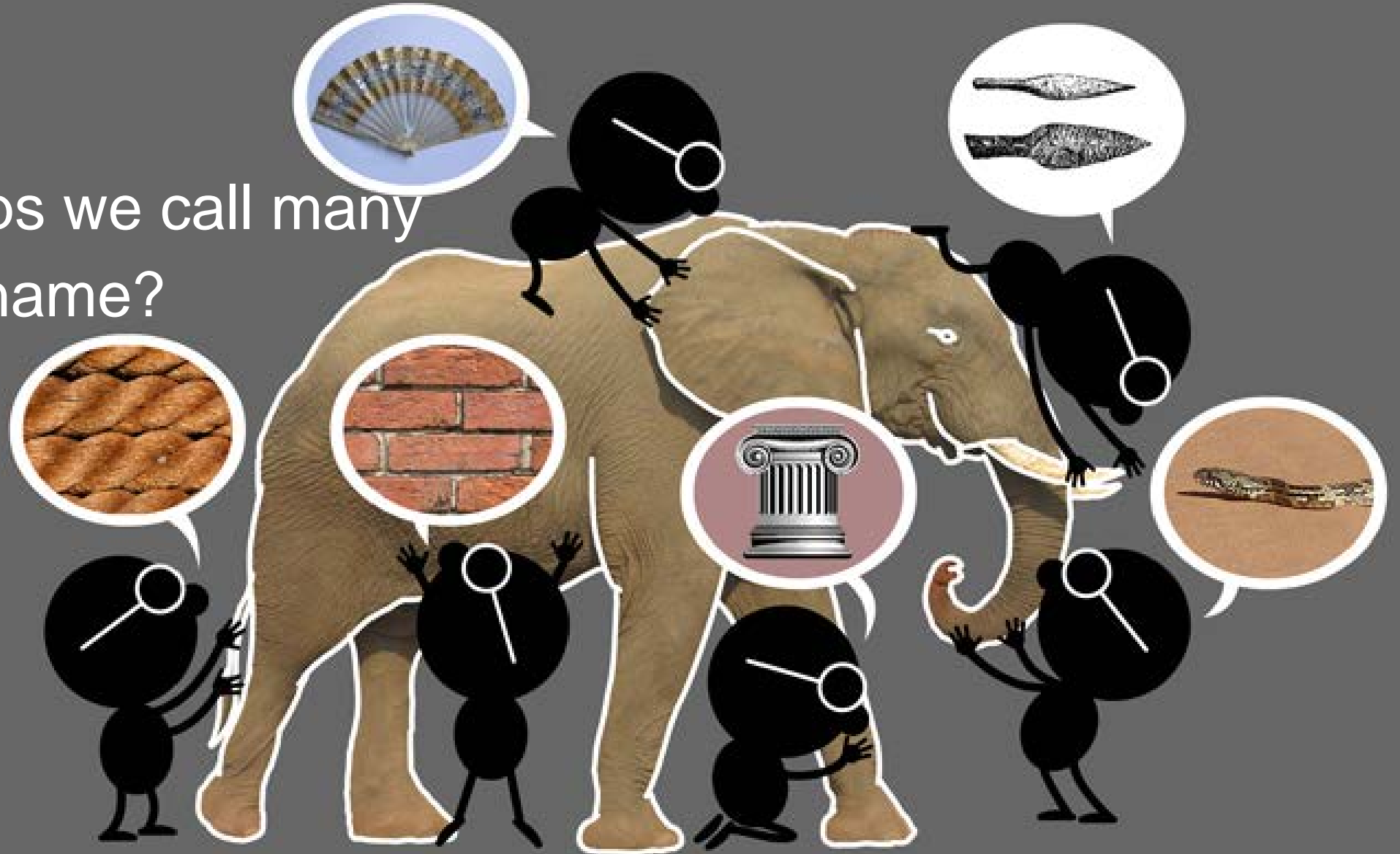
Crop Circles—Dorset, UK—2015

...BIM IS AN ELEPHANT.



As in the fable of the elephant, we perceive one thing as many.

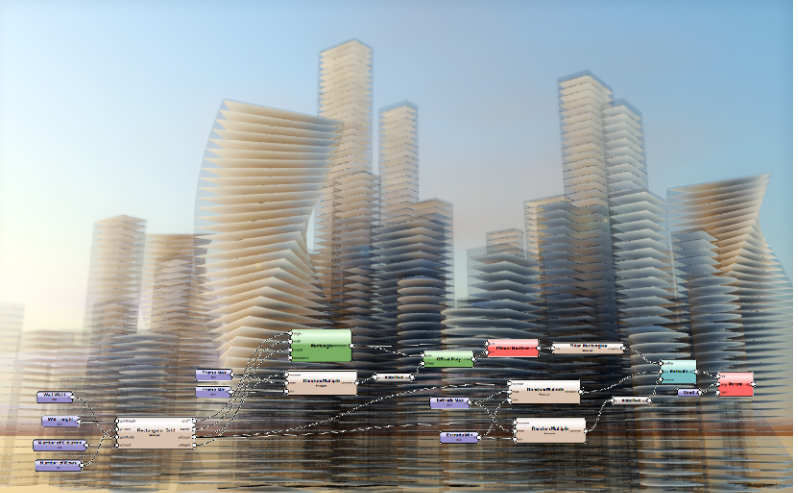
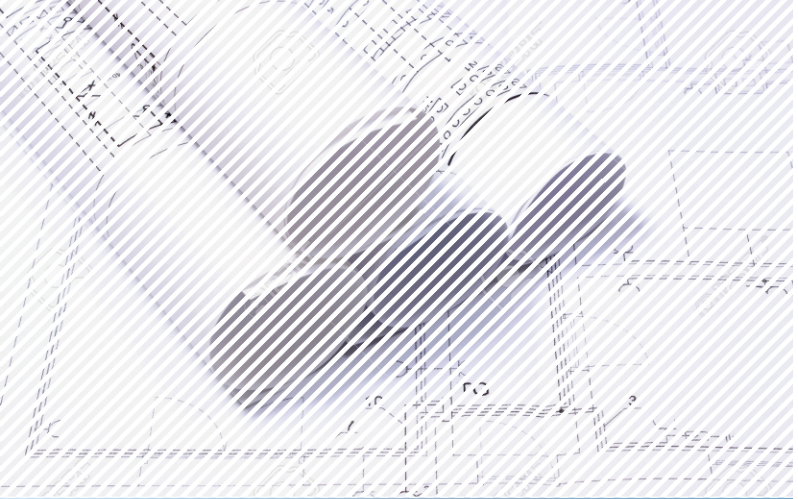
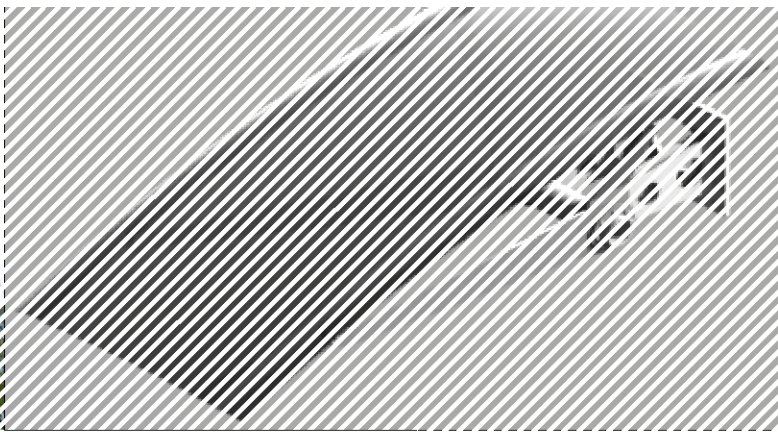
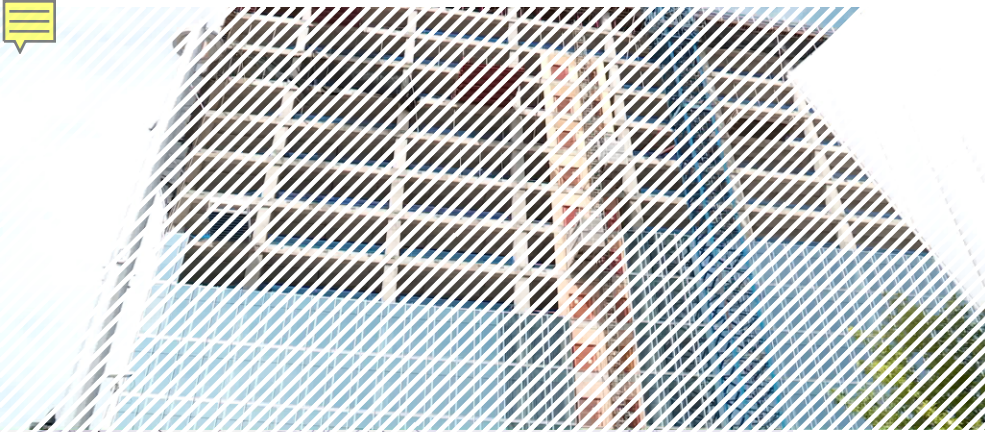
Or.. Is it perhaps we call many things by one name?























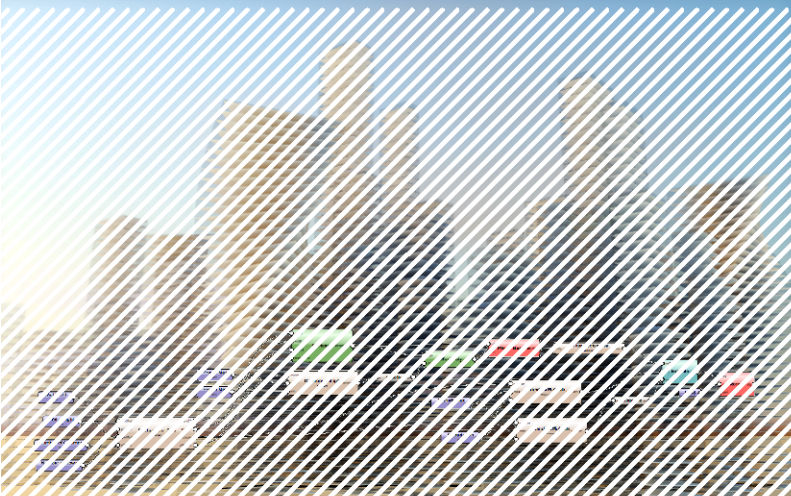
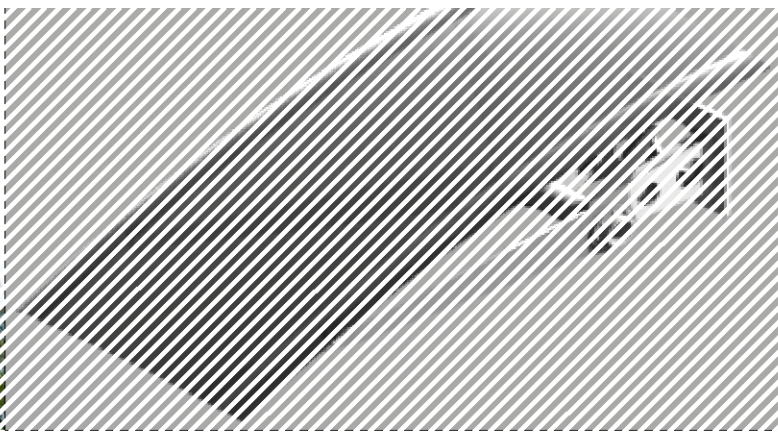
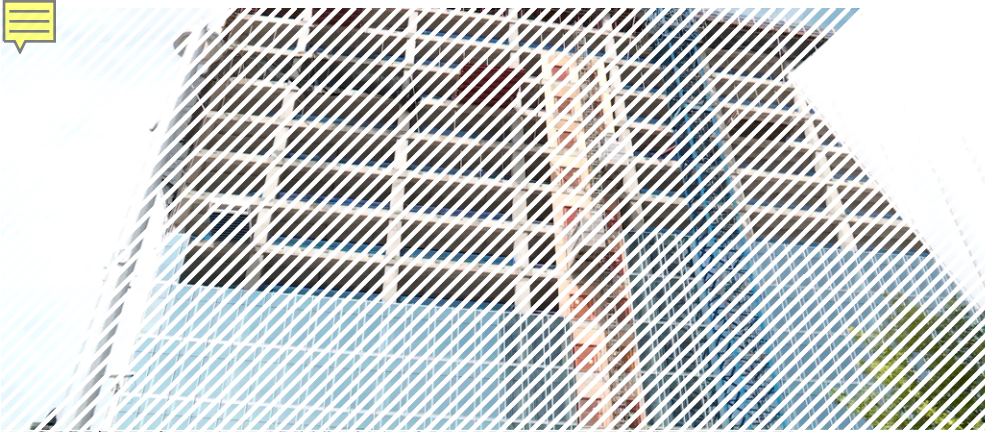
There is not 1 “planetary” BIM, but rather *5 things* we call “BIM”























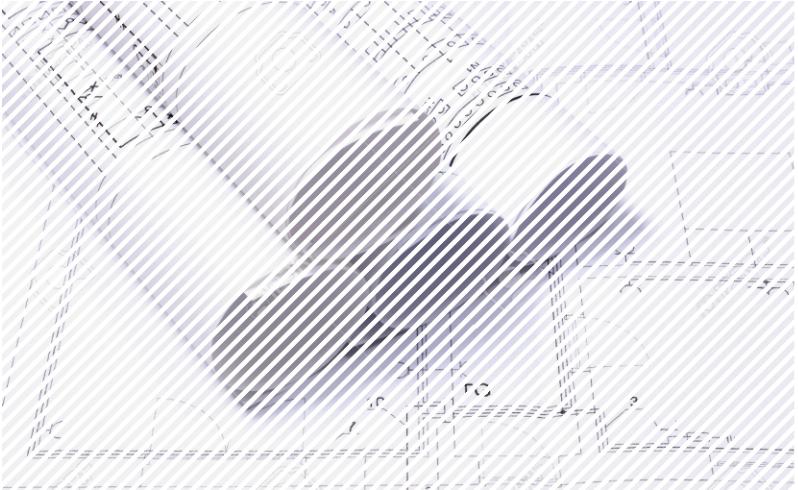
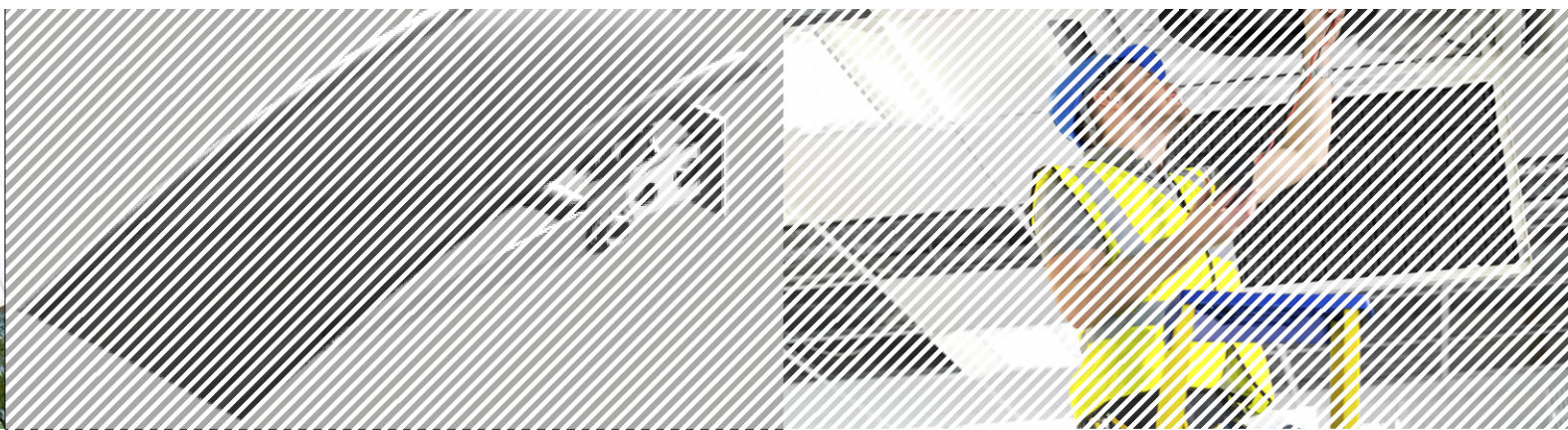
# 3 — the 5 BIMs























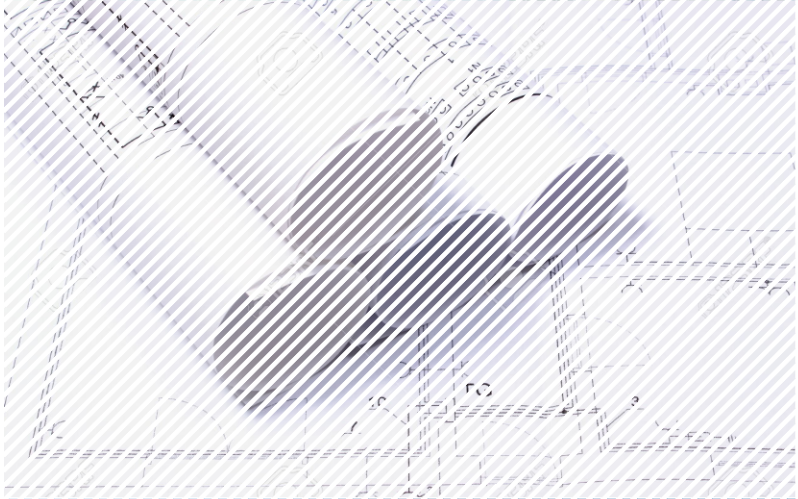
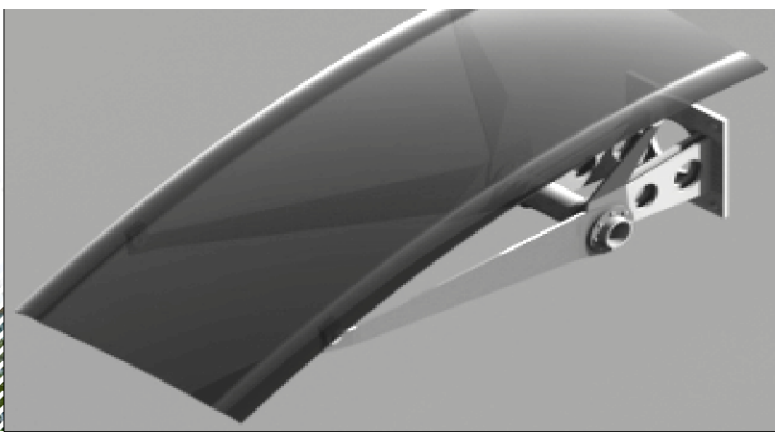
Kind of BIM	Concept	Design Intent	Constructability	Fabrication	Operations
Phase	Pre-design through Schematic Design	Schematic Design through Construction Docs	Construction (General Contractor)	Construction (Subcontractor)	Post-construction
LOD (United States)	100	300	350	400	N/A
Description	This is the Design / Competition Team's domain	This is the "BIM for Documentation"	This BIM doesn't produce any documents directly; it is really a database to drive the construction process	Highly detailed models used to produce shop drawings, controlling bar schedules, or even to drive CNC equipment. Some, but not all, are integrated back into the construction model.	This model operates the building and its maintenance. Also known as "CMMS" software
Contents	Algorithmic Definition	•		•	
	Geometry	•	•	•	
	Ontology		•	•	•
	Parametric Data		•	•	•
	Non Param. Properties		•	•	•
Deliverables	Rendered Images; Export Geometry	Contract Drawings (Paper or Electronic)	3D Coordination ("Clash detection"); 4D Schedules; 3D Budgets	Shop models and drawings output to fabricate	Work Orders; Maintenance Schedules; Invoices; Trouble reports
Platforms					
					
					
					























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Platforms						
						
						
						

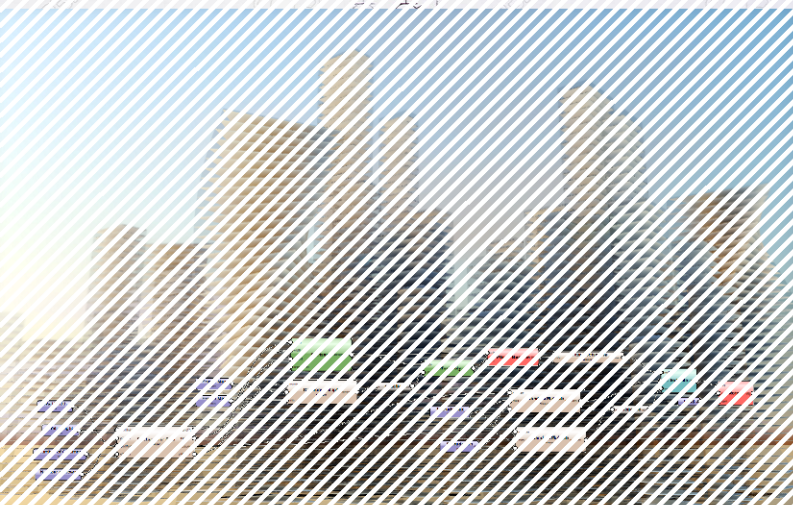
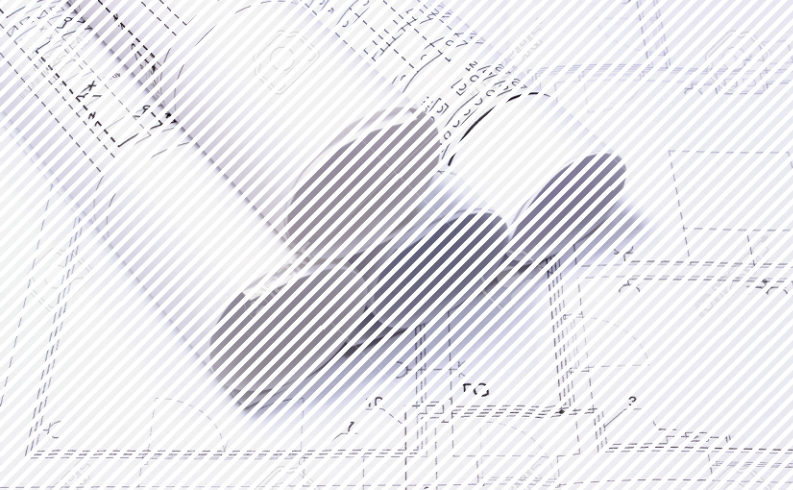
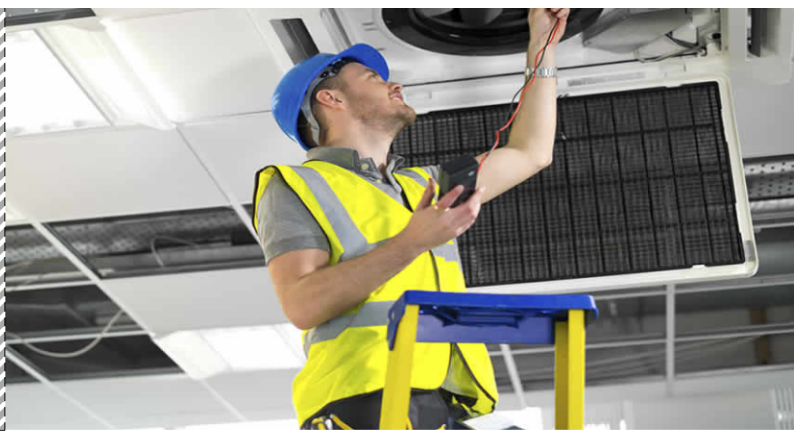
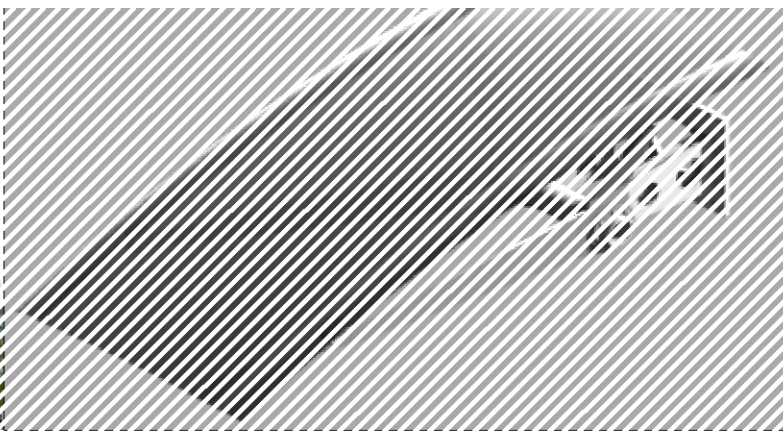
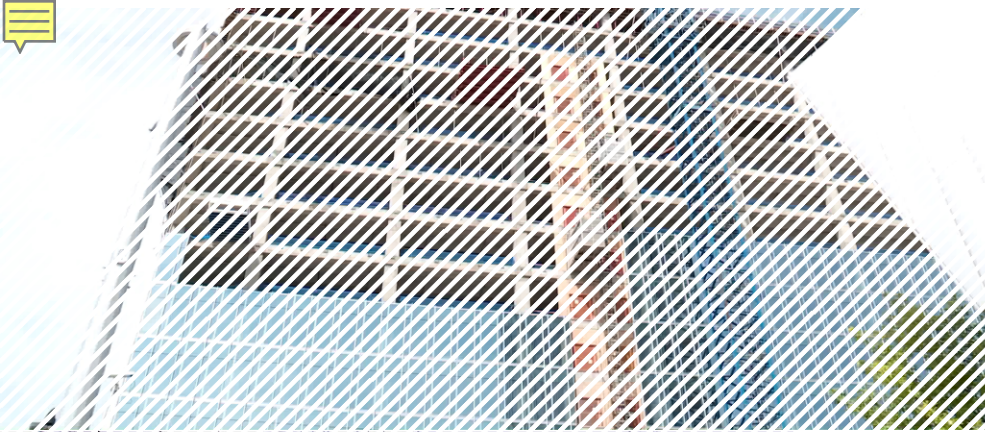






















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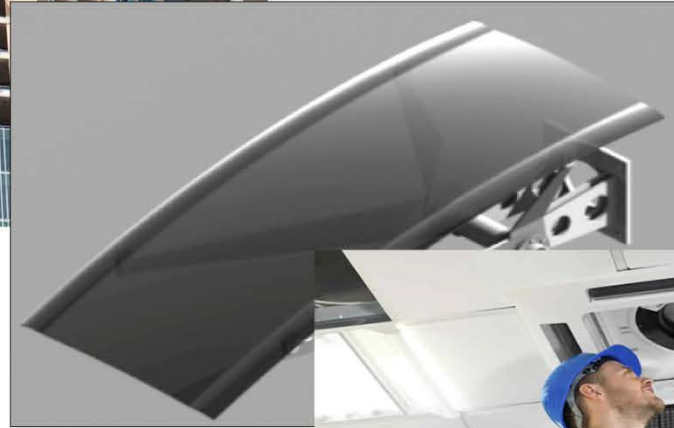
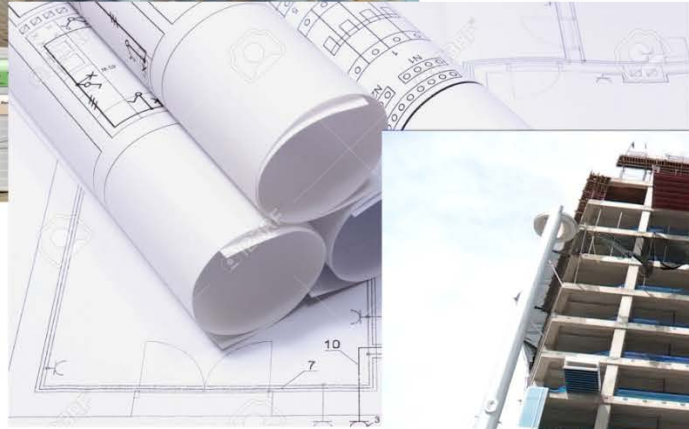
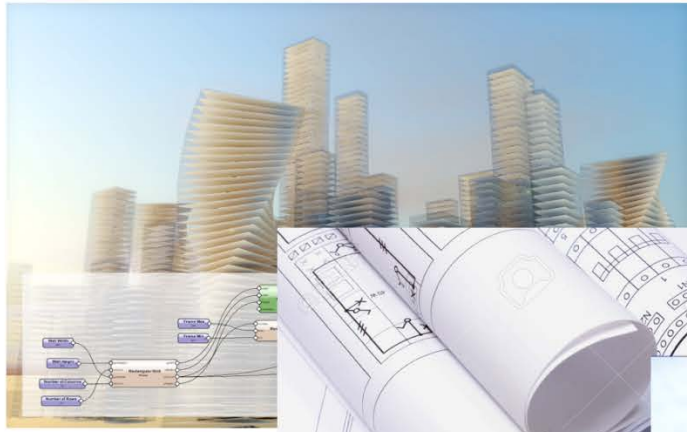


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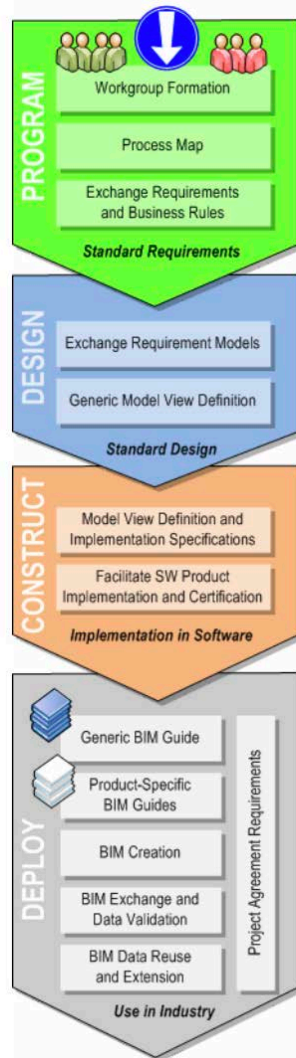




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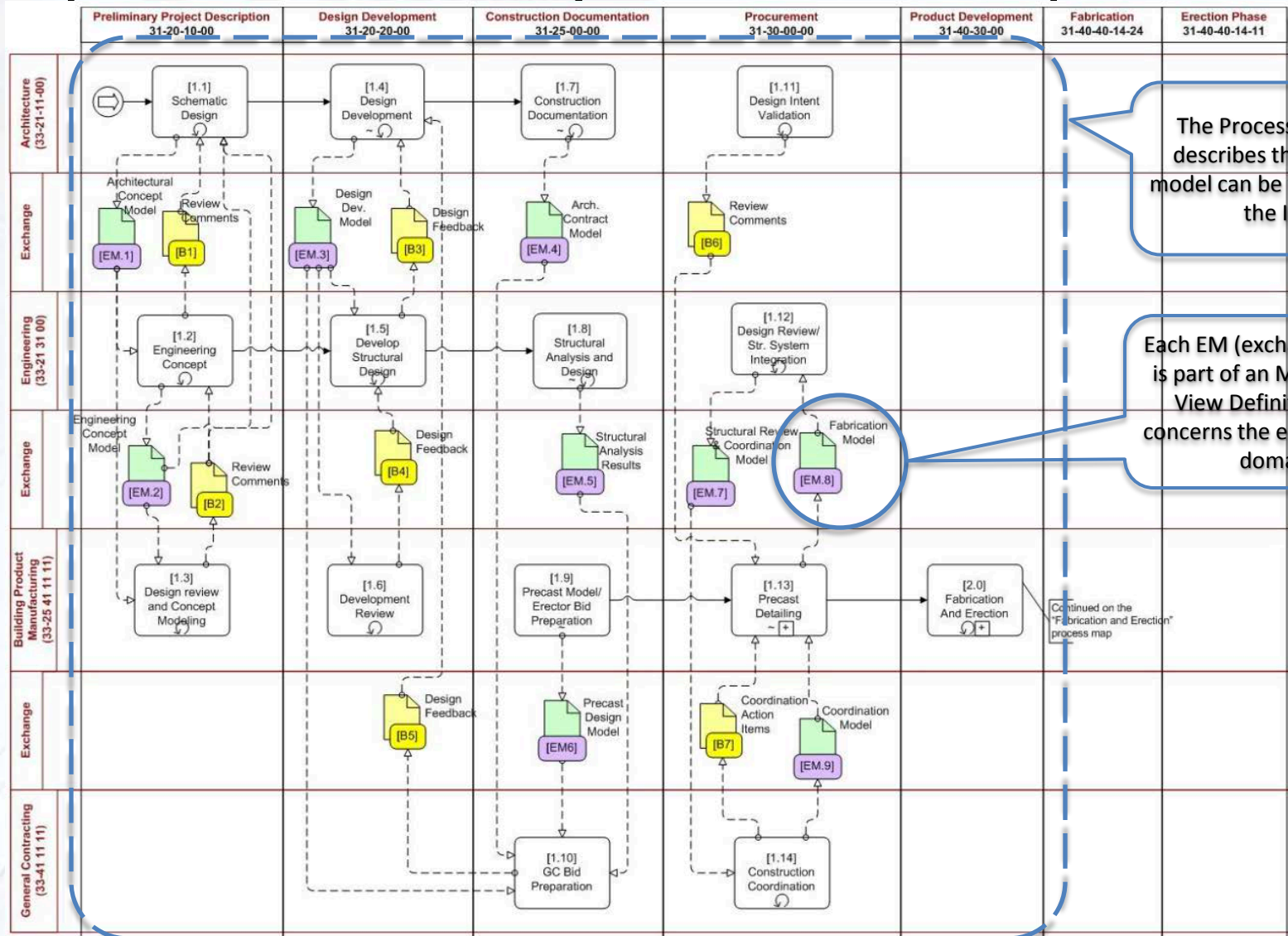


# Established National BIM Standard Process (the “chevrons”)



- Ø1—“Programming” (Sometimes called “IDM”)
  - Assemble Team
  - Create a Process Map
  - Determine High-level Exchange Requirements
- Ø2—“Design”
  - Develop Detailed Exchange Requirements
  - Create Preliminary Model-View Definition (“MVD”)
- Ø3—“Implementation”
  - Create Final Model-View Definition Specs (for Software Developers to Implement)
- Ø4—“Testing”
  - Get it in Real-world Models
  - Validate that it performs as expected

# Example of NBIMS-style Process Map



The Process Map that describes the business model can be thought of as the IDM

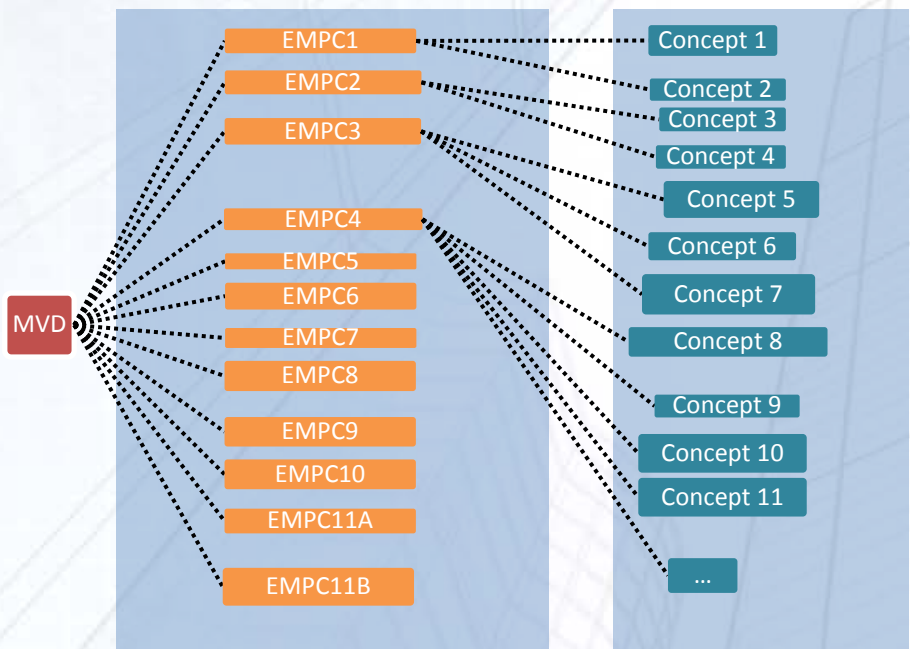
Each EM (exchange model) is part of an MVD (Model View Definition) that concerns the entire project domain

Continued on the "Fabrication and Erection" process map



# 1 MVD = many "Concepts"

- Concepts get combined and recombined into Exchange Models



Concepts

	EMPC1	EMPC2	EMPC3	EMPC4	EMPC5	EMPC6	EMPC7	EMPC8	EMPC9	EMPC10	EMPC11	EMPC12
	BC	EC	PCD	EDD	AC	ECO	PDC	SRC	EAR	FPCD	PD	FED
PCI-040	R	R	R	R	R	R	R	R	O	R	R	R
PCI-042	R		R	R	R	R	R	R		R		
PCI-043	R		R	R	R	R	R	R		R		
PCI-044	R	R	R	R	R	R	R	R		R		
PCI-047	R	R	R	R	R	R	R	R	R	R		
PCI-048	R	R	R	R	R	R	R	R	R	R		
PCI-050	R	R	R	R	R	R	R	R	R	R		
PCI-052	R	R	R	R	R	R	R	R	R	R		
PCI-053	R	R	R		R	R		R	R	R	R	R
PCI-054	R	R	R	R	R	R	R	R	R	R	R	R
PCI-056		R	O		R	R		R	R		R	R
PCI-057			O					R			R	R
PCI-058	R		O		R	R		R				
PCI-059	R	R	R	R	R	R	R	R	R	R	R	R
PCI-060	R	R	R	R	R	R	R	O	R	R	R	R
PCI-061	R	R	R	R	R	R	R	R	R	R	R	R
PCI-062	R	R	R	R	R	R	R	R	R	R	R	R
PCI-063	R	R	R	R	R	R	R	R	R	R	R	R
PCI-064	R	R	R	R	R	R	R	R	O	R	R	R
PCI-066				R	R		R	R		R	R	R
PCI-067	R		R	R	R	R	R	R		R	R	R
PCI-068	R	R	R			R			R			
PCI-069	R	R	R			R			R			
PCI-070	R	R	R			R			R			
PCI-071	R	R	R			R		R	R	R	R	R
PCI-072			O	R		R	R	R	R	R	R	R
PCI-073		R	R			R		R	R	R	R	R
PCI-074	R	R	R		R	R		R	R	R	R	R
PCI-077	R	R	R		R	R		R	R	R	R	R
PCI-081	R	R	R	R	R	R	R	R	R	R	R	R
PCI-086						R		R	R		R	R
PCI-088			O	R		R	R	R	R	R	R	R
PCI-091								R			R	R
PCI-096	R		R		R	R					R	R
PCI-097						R		R	R		R	R
PCI-098			R	R		R	R	R	R	R	R	R
PCI-099			O			R		R	R	R	R	R
PCI-100						R		R	R	R	R	R
PCI-101			O			R		R	R	R	R	R
PCI-102						R		R	R	R	R	R
PCI-103			O	R		R	R	R	R	R	R	R
PCI-104			O	R		R	R	R	R	R	R	R

# Successful Examples of National BIM Standards



- Building Information Modeling Standard for Precast Concrete Construction
  - Georgia Tech
  - Technion
  - Pankow Foundation
  - Precast Concrete Institute

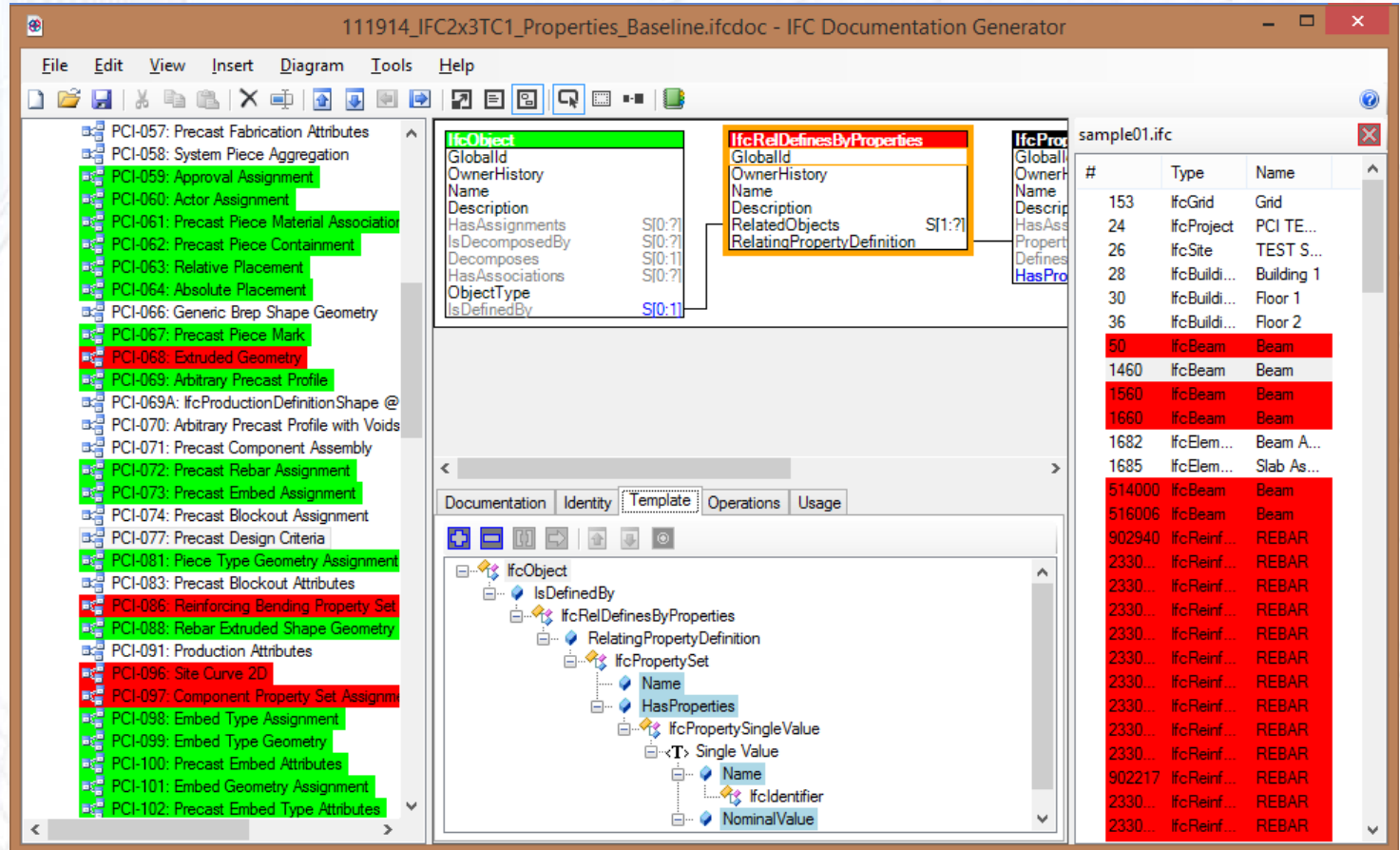


- AISC EM-11 Final Steel Detailing Model
  - Georgia Tech
  - Fiatch
  - AISC



# New(ish) Tools for Optimizing the Process: IFCdoc

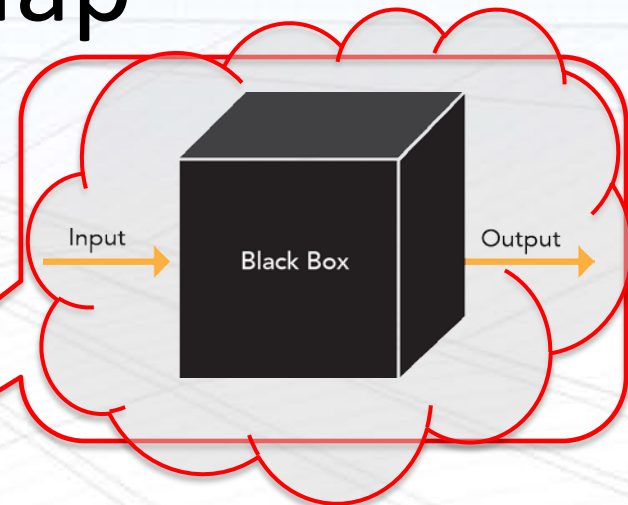
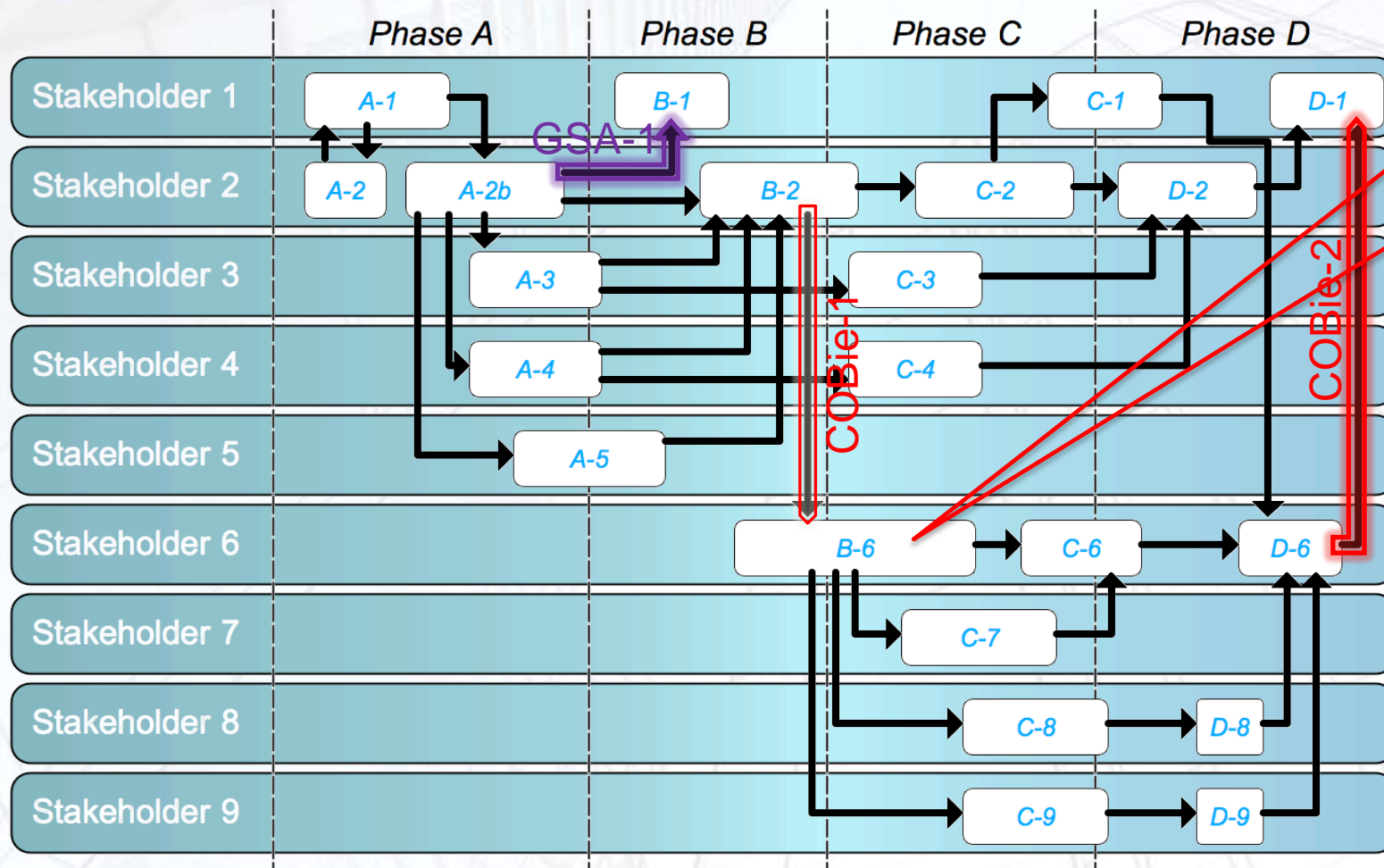
- Defines MVDs
- Exports mvdXML (a machine-readable MVD)
- Validates IFC files for conformance with MVDs



The screenshot shows the IFC Documentation Generator interface. On the left, a tree view lists various MVDs (e.g., PCI-057: Precast Fabrication Attributes, PCI-058: System Piece Aggregation, etc.). The main area displays the 'IfcObject' and 'IfcRelDefinesByProperties' classes with their properties and relationships. On the right, a table titled 'sample01.ifc' lists IFC objects with columns for ID, Type, and Name.

#	Type	Name
153	IfcGrid	Grid
24	IfcProject	PCI TE...
26	IfcSite	TEST S...
28	IfcBuildi...	Building 1
30	IfcBuildi...	Floor 1
36	IfcBuildi...	Floor 2
50	IfcBeam	Beam
1460	IfcBeam	Beam
1560	IfcBeam	Beam
1660	IfcBeam	Beam
1682	IfcElem...	Beam A...
1685	IfcElem...	Slab As...
514000	IfcBeam	Beam
516006	IfcBeam	Beam
902940	IfcReinf...	REBAR
2330...	IfcReinf...	REBAR
2330...	IfcReinf...	REBAR
2330...	IfcReinf...	REBAR
2330...	IfcReinf...	REBAR
2330...	IfcReinf...	REBAR
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2330...	IfcReinf...	REBAR
902217	IfcReinf...	REBAR
2330...	IfcReinf...	REBAR
2330...	IfcReinf...	REBAR

# Swim Lane Diagram as Process Map









**BUILDING  
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