National Institute of Building Sciences

Provider Number: G168

Rethinking 7 Misconceptions about Interoperability

BI17TH1B

Robert F. Anderson

12 January, 2017

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

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

Learning Objectives

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?

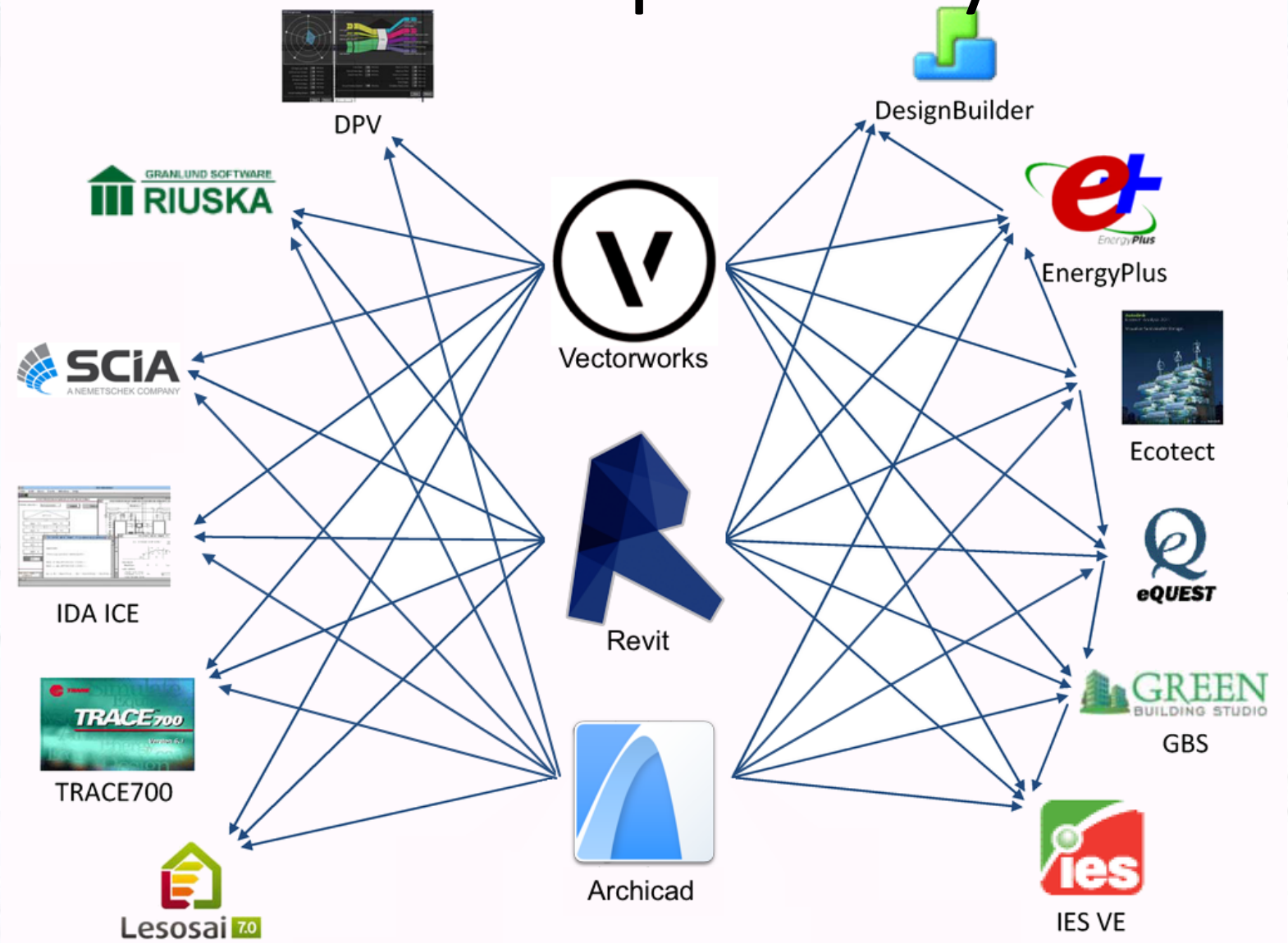
BUILDING INNOVATION 2017
National Institute of BUILDING SCIENCES
CONFERENCE & EXPO

Topics

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

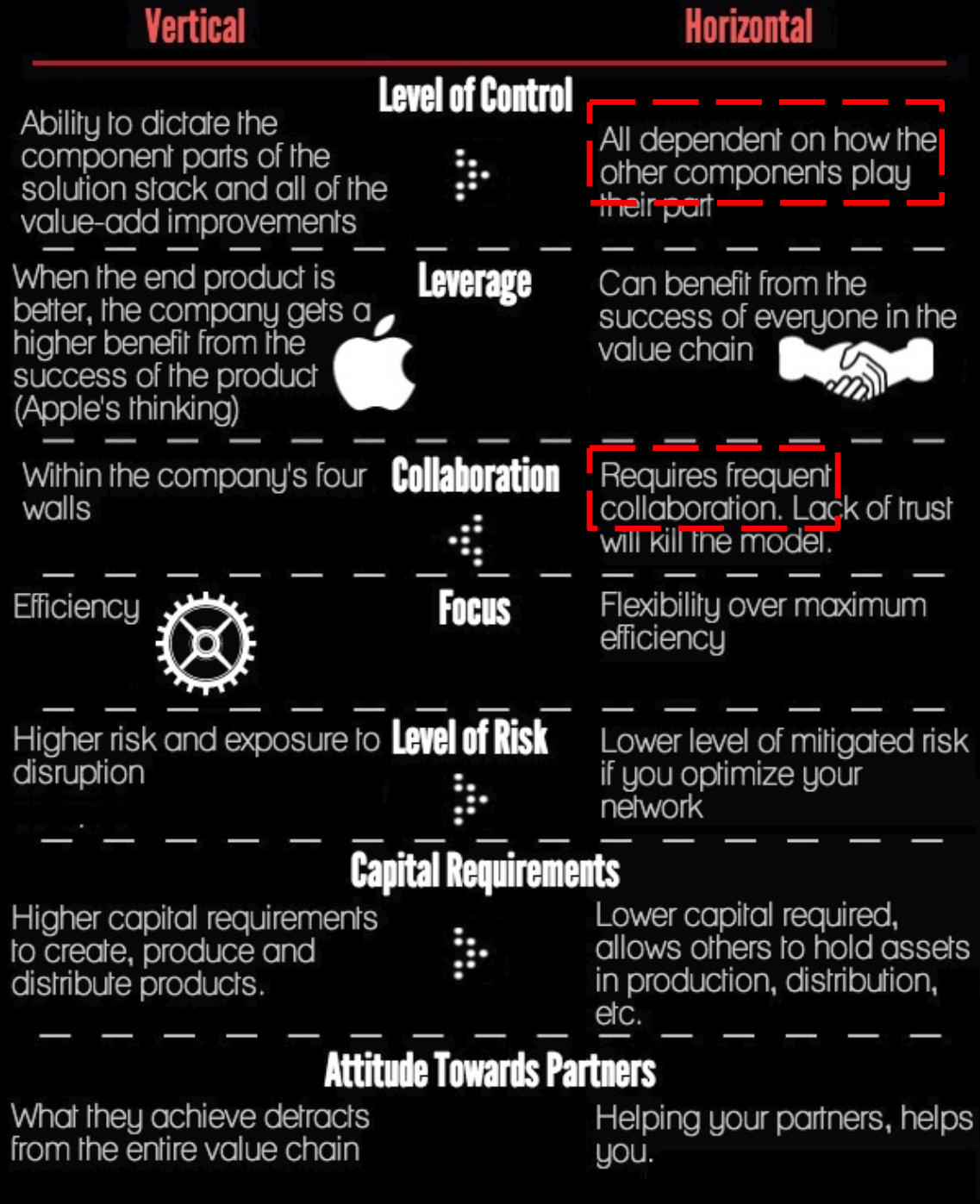
CONTINUING EDUCATION AIA

Why do we need Interoperability?



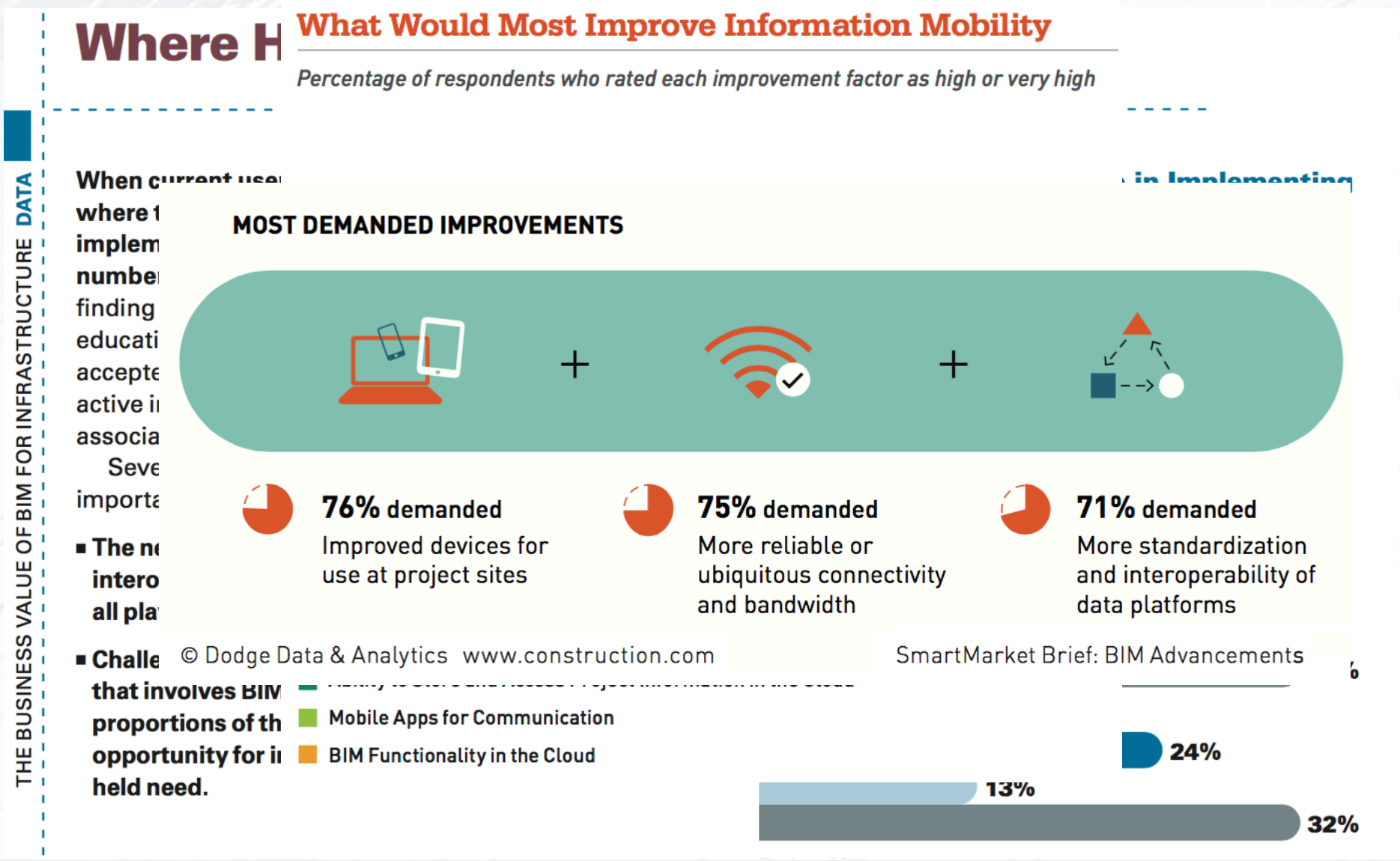
Because (1): No single software does it all

Because (2): Vertical vs. Horizontal



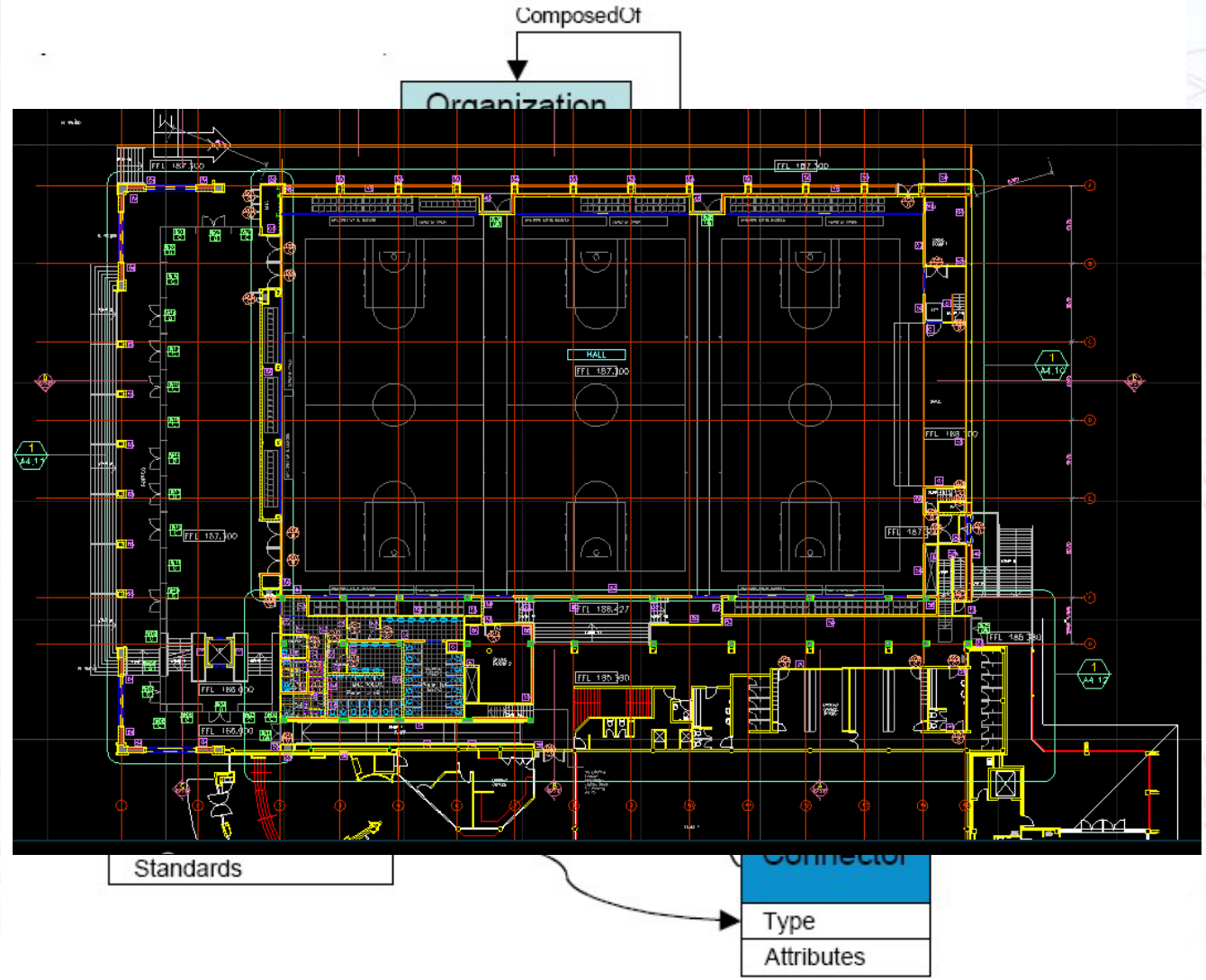
Why do we need Interoperability?

Because (3):
Demand
from Users



http://analyticsstore.construction.com/smartmarket-reports.html

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

BUILDING INNOVATION 2017
National Institute of BUILDING SCIENCES
CONFERENCE & EXPO

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.

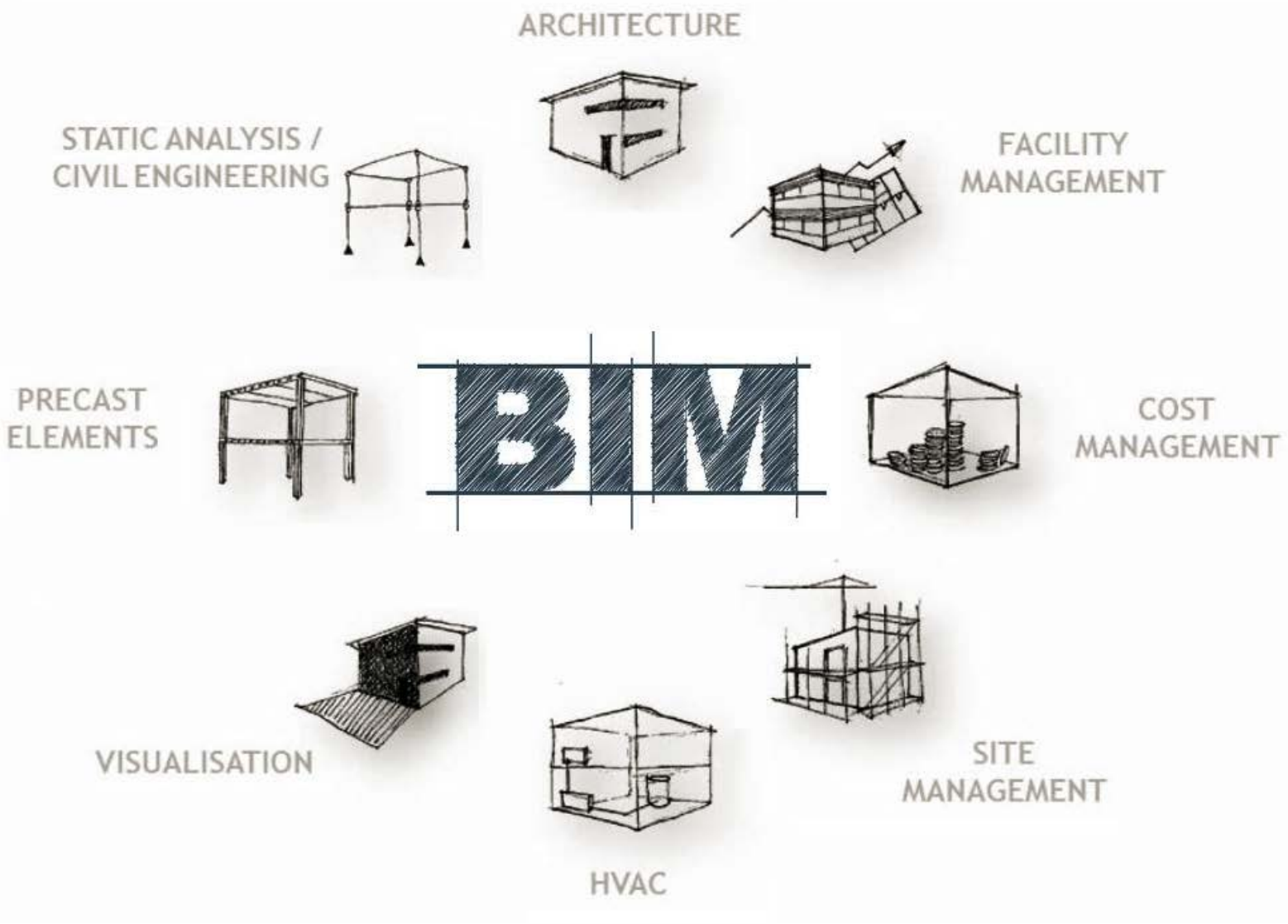
IFC4 and Rising to User Expectations

2 — BIM Metaphors

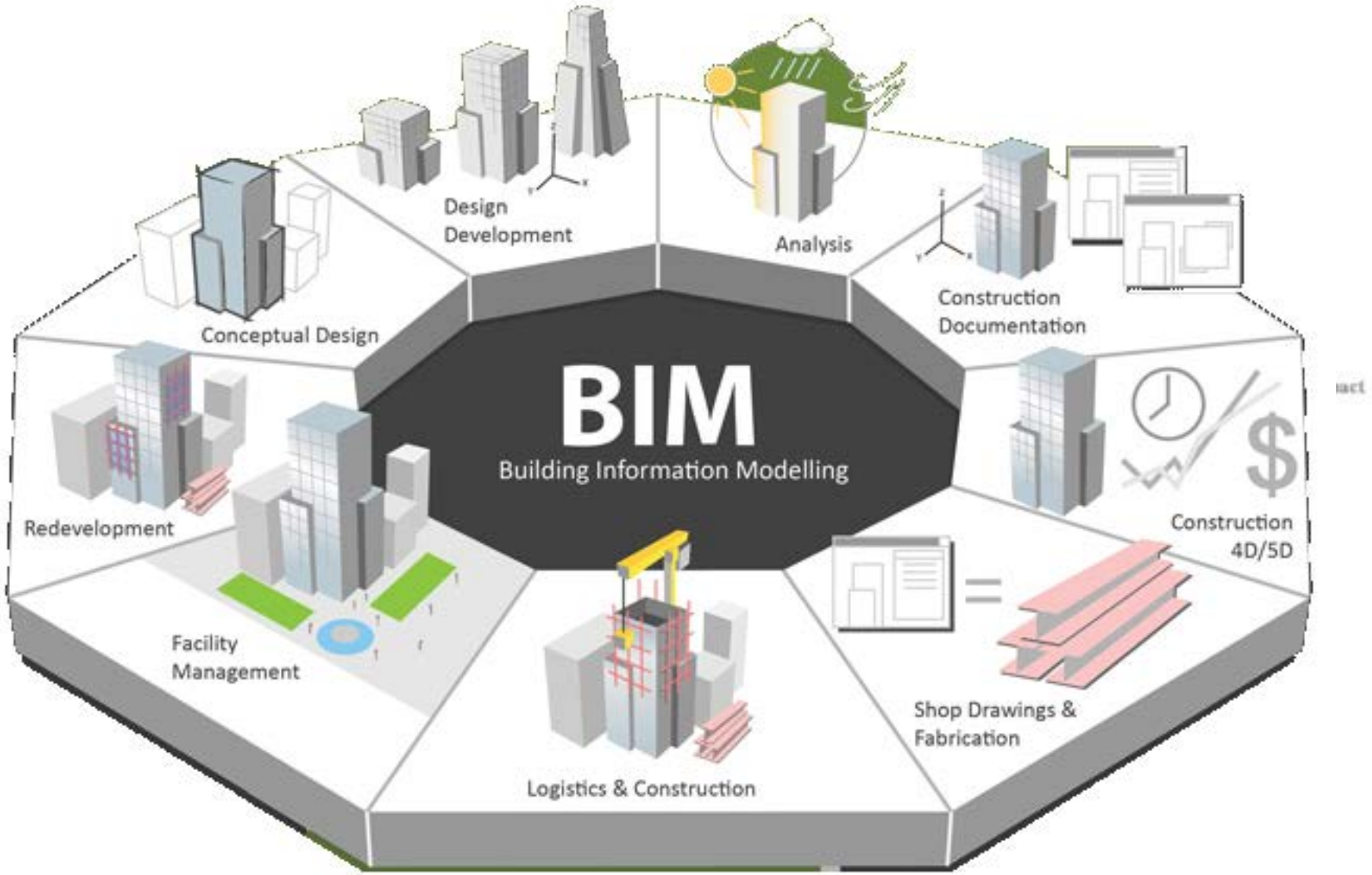
PLANET as a Metaphor for BIM

“Blue Marble”— Apollo 17—December 1972

BIM AS PLANET — WITH TEAM AS SATELLITES



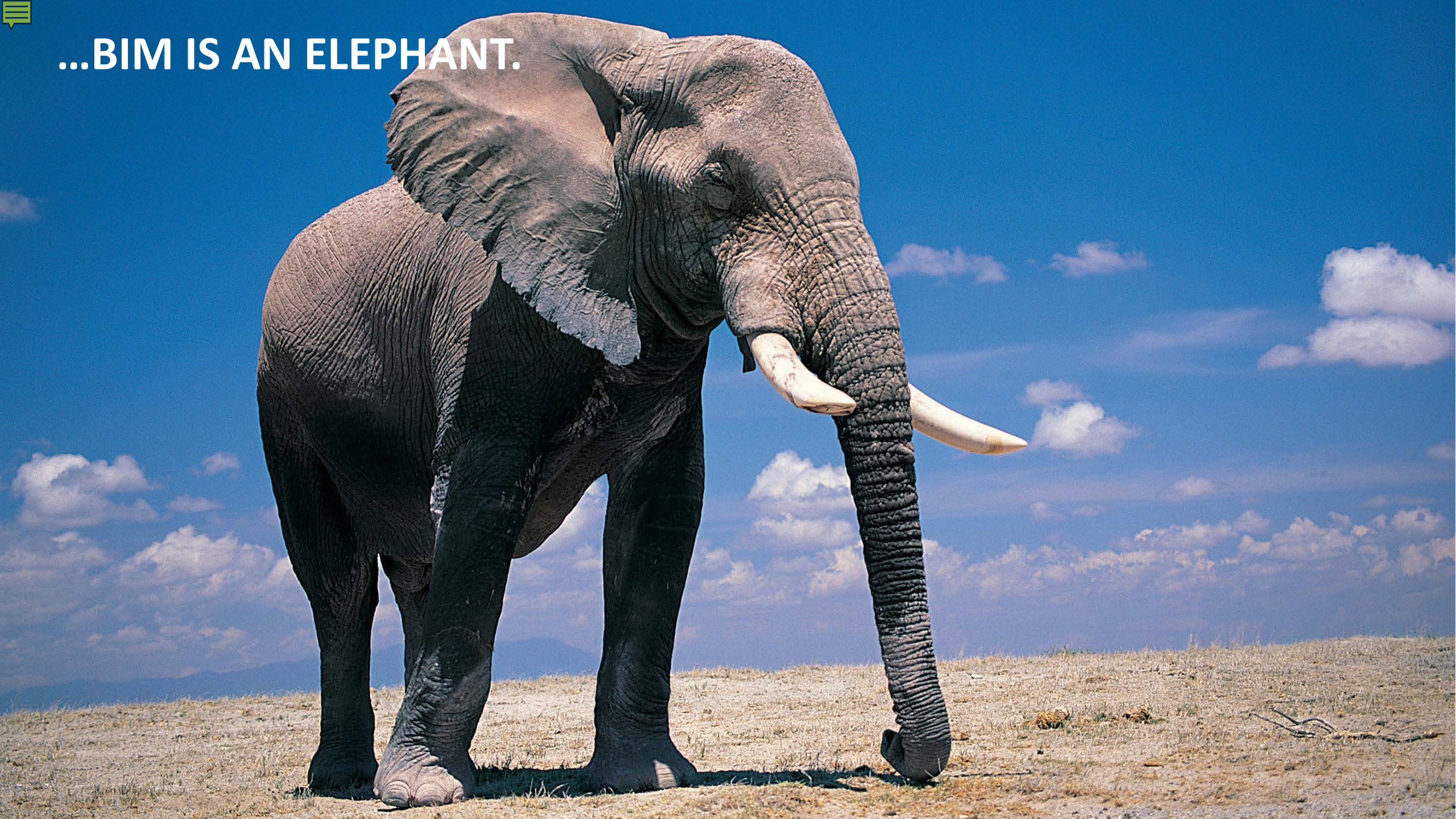
BIM AS PLANET — WITH LIFECYCLE AS SATELLITES



BIM IS NOT A PLANET…

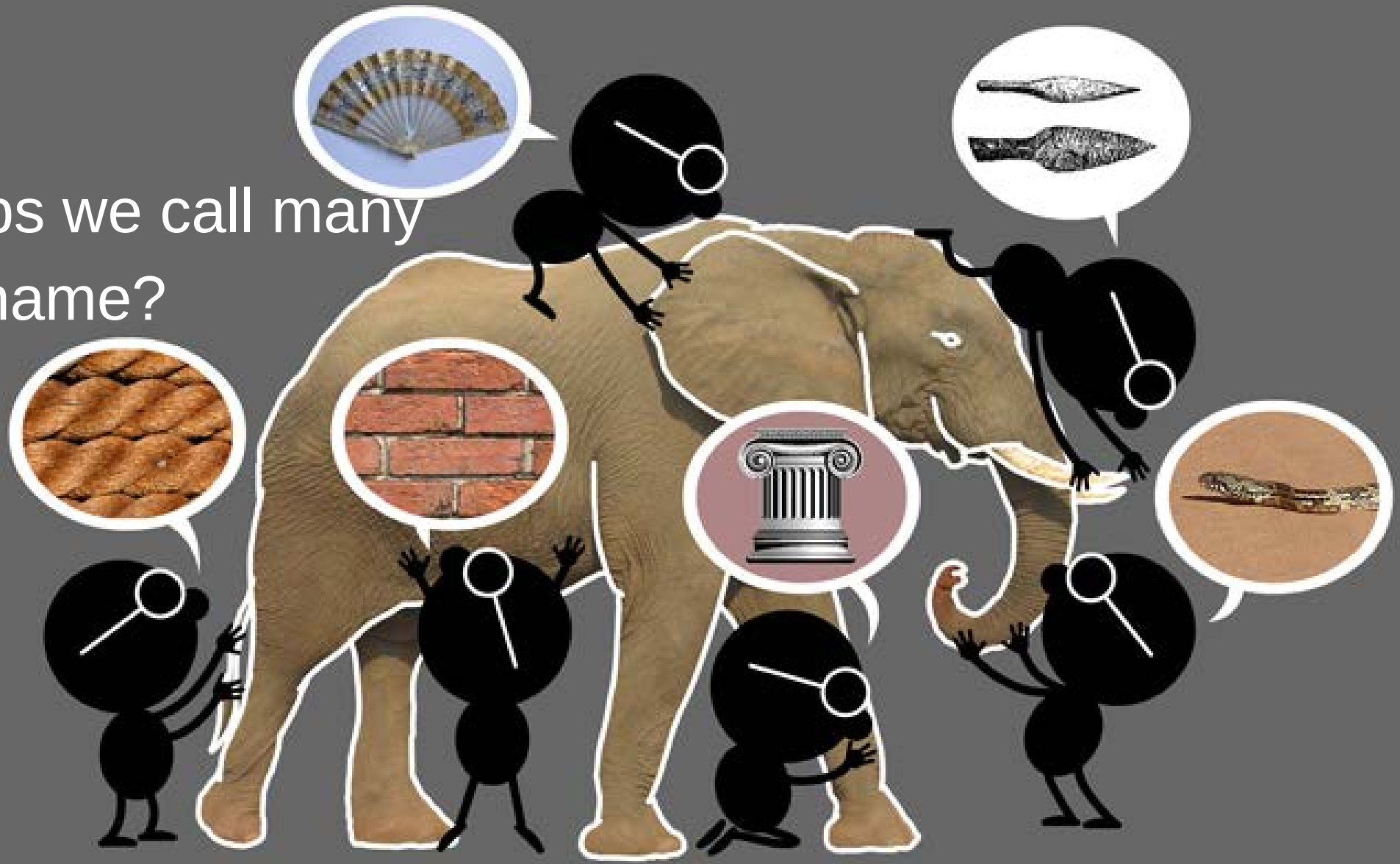
Crop Circles—Dorset, UK—2015

…BIM IS AN ELEPHANT.



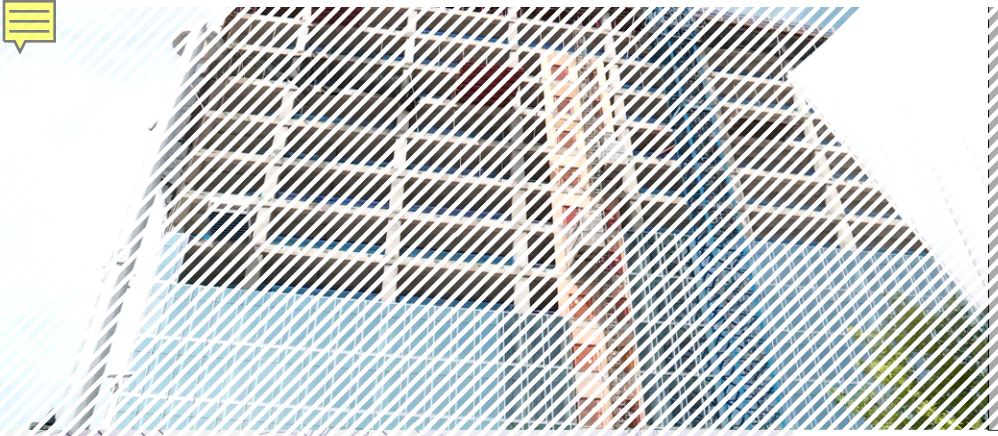
As in the fable of the elephant, we perceive one thing as many.

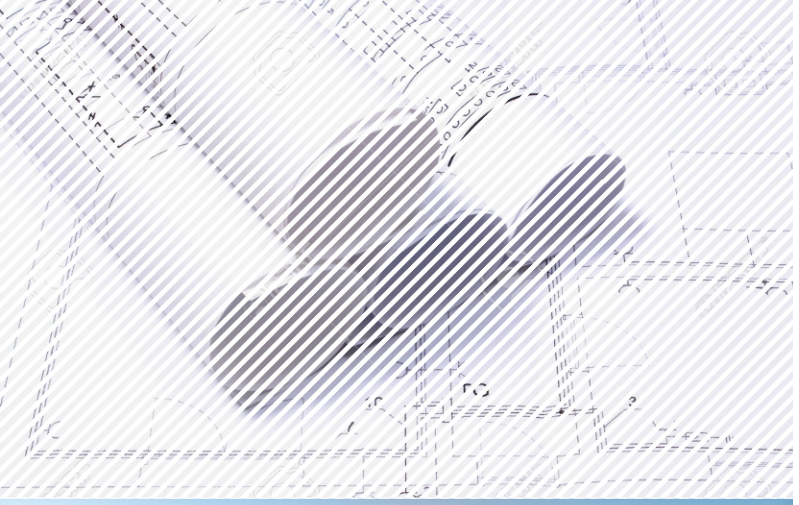
Or.. Is it perhaps we call many things by one name?

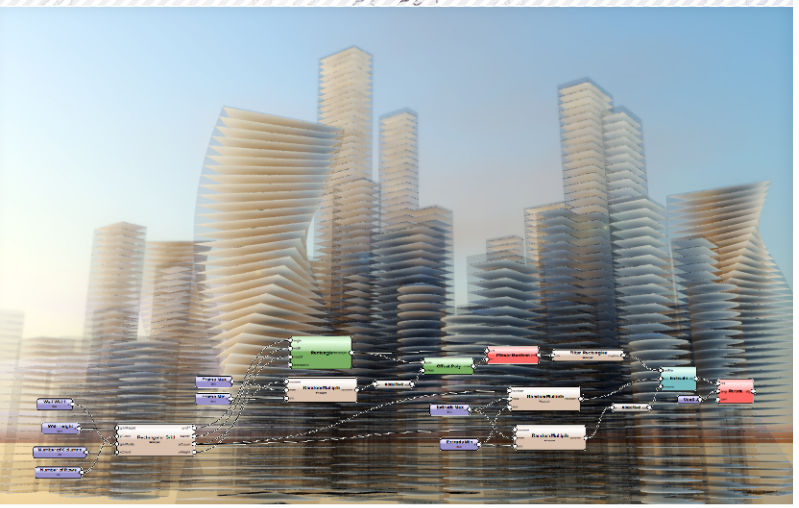


There is not 1 “planetary” BIM, but rather ***5 things*** we call “BIM”

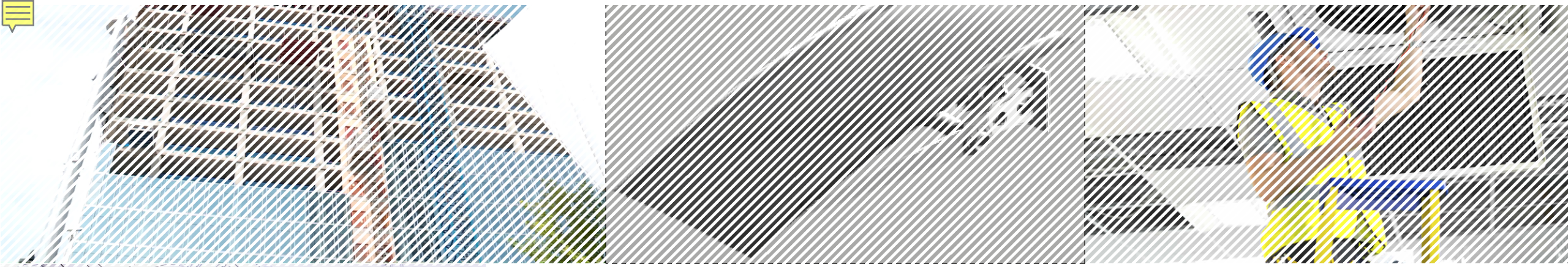
3 — the 5 BIMs

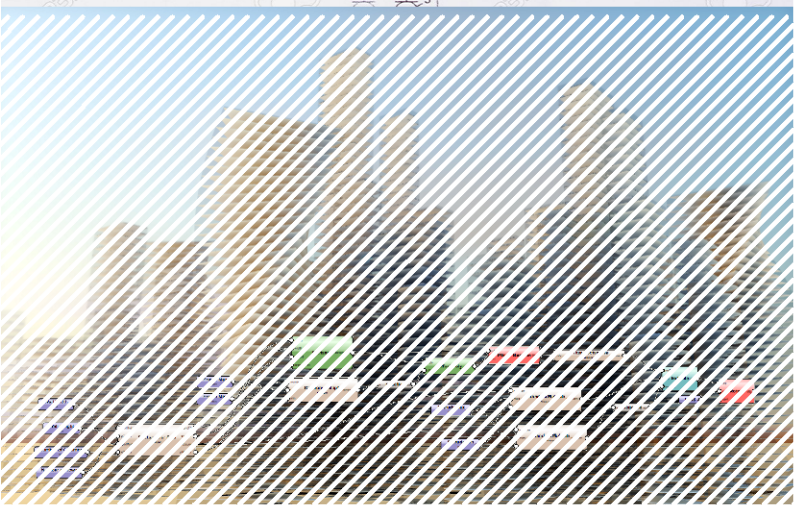




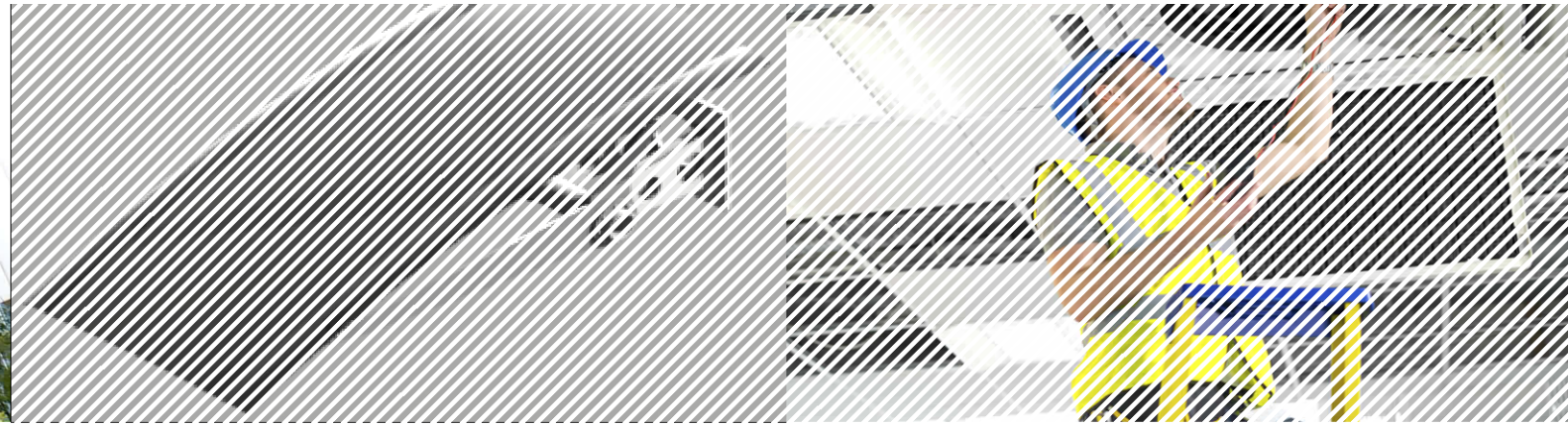


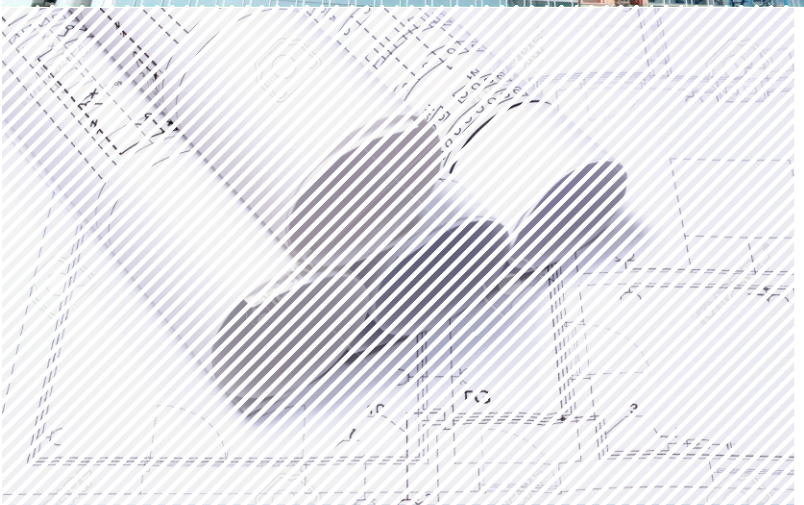
Kind of BIM		Concept	Design Intent	Constructability	Fabrication	Operations
Phase		Pre-design through Schematic Design	Schematic Design through Construction Docs	Construction (General Contractor)	Construction (subcontractor)	Post-construction
LOD (United States)		100	300	350	400	N/A
Description		This 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, reinforcing 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; 5D Budgets	Shop models and drawings output to robotic fabrication	Work Orders; Maintenance schedules; Invoices; Trouble reports
Platforms						

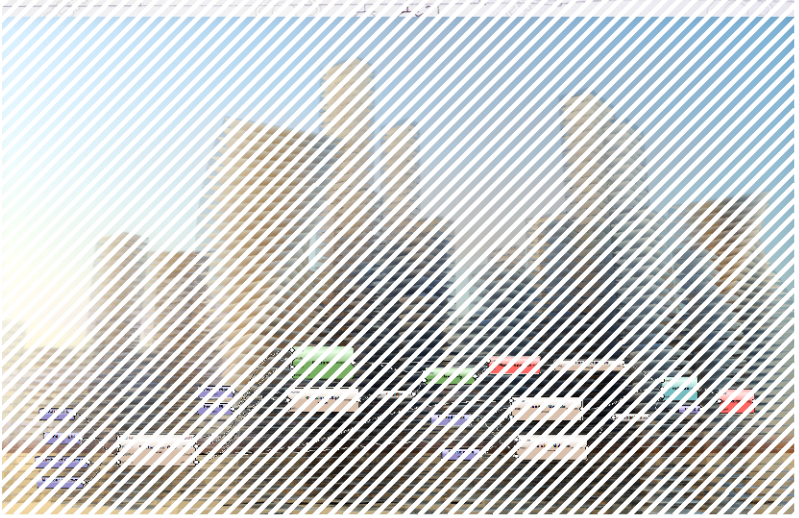




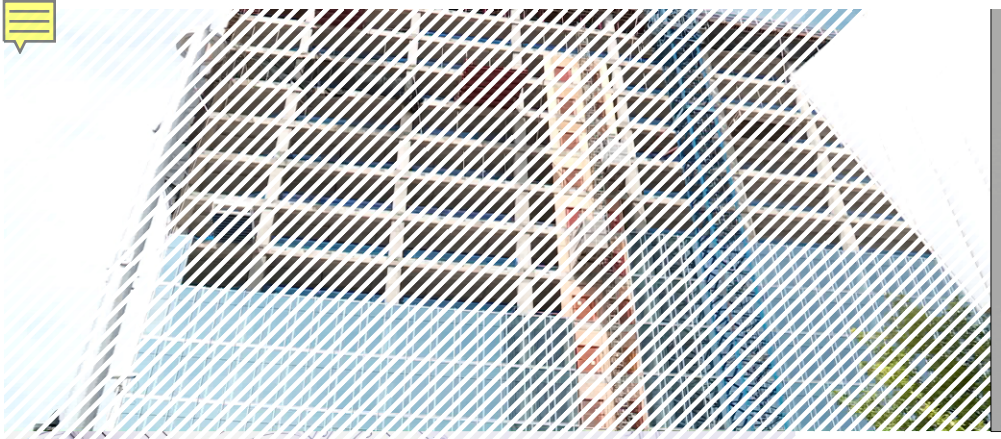
Kind of BIM		Concept	Design Intent	Constructability	Fabrication	Operations
Phase		Pre-design through Schematic Design	Schematic Design through Construction Docs	Construction (General Contractor)	Construction (Subcontractor)	Post-construction
LOD (United States)		100	300	350	400	N/A
Description		This 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, reinforcing 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; 5D Budgets	Shop models and drawings; output to robotic fabrication	Work Orders; Maintenance schedules; invoices; Trouble reports
Platforms						

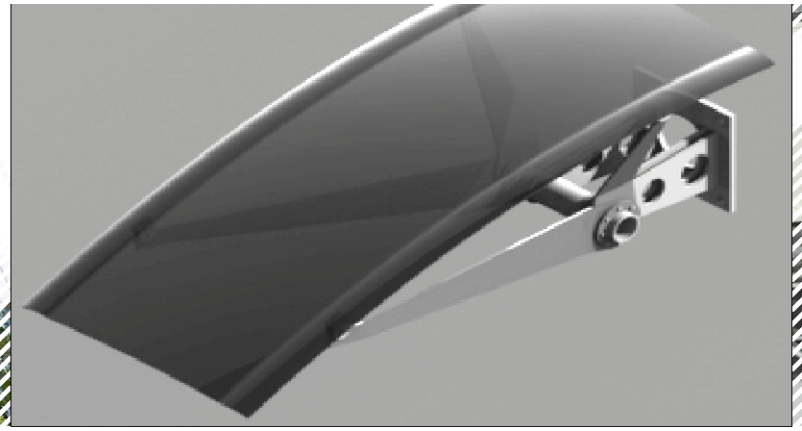


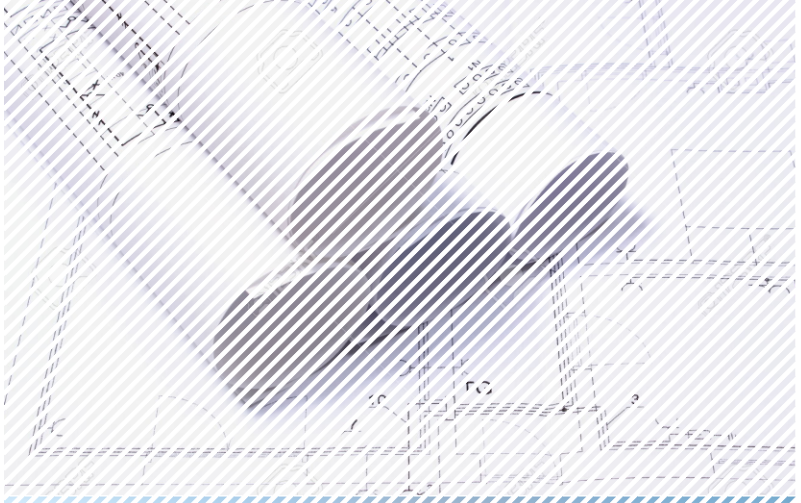


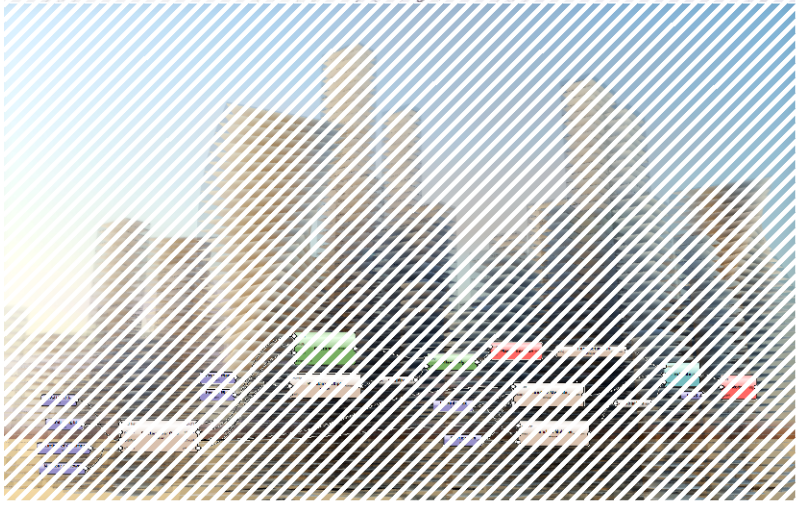


Kind of BIM		Concept	Design Intent	Constructability	Fabrication	Operations
Phase		Pre-design through Schematic Design	Schematic Design through Construction Docs	Construction (General Contractor)	Construction (subcontractor)	Post-construction
LOD (United States)		100	300	350	400	N/A
Description		This 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, reinforcing 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; 5D Budgets	Shop models and drawings; output to robotic fabrication	Work Orders; Maintenance schedules; invoices; Trouble reports
Platforms						
				SMC		

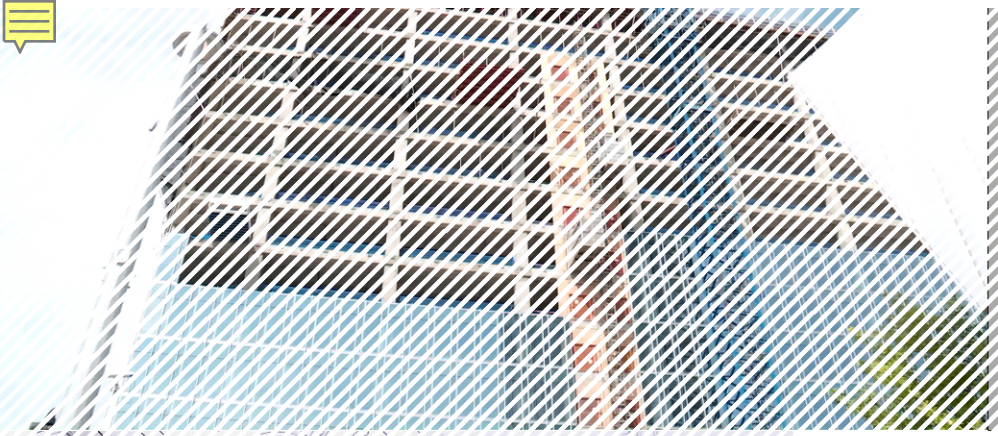


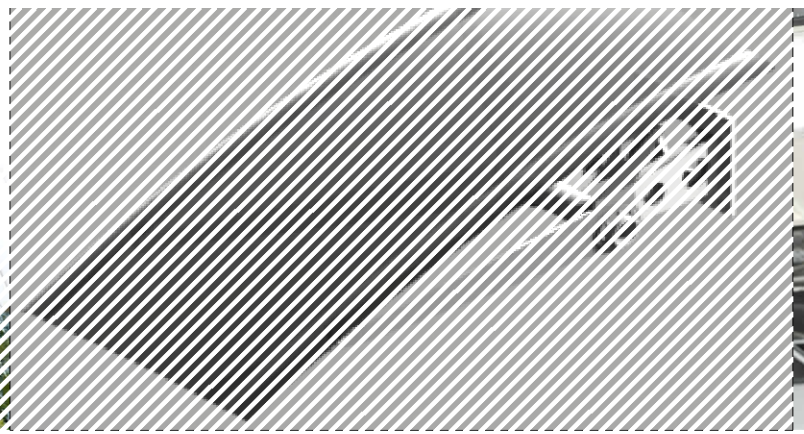


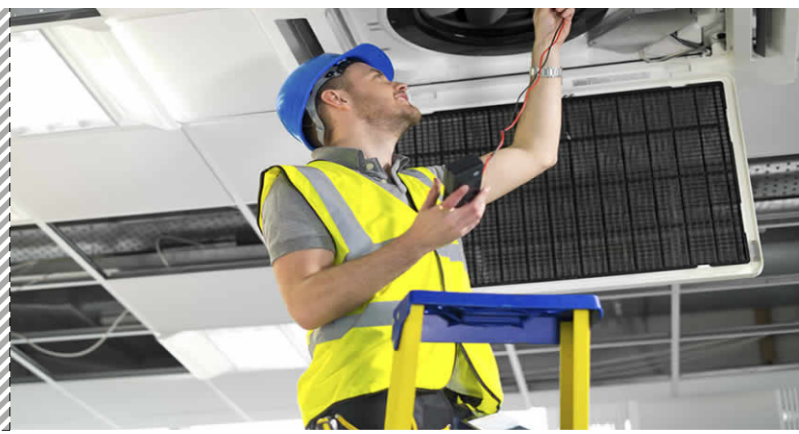


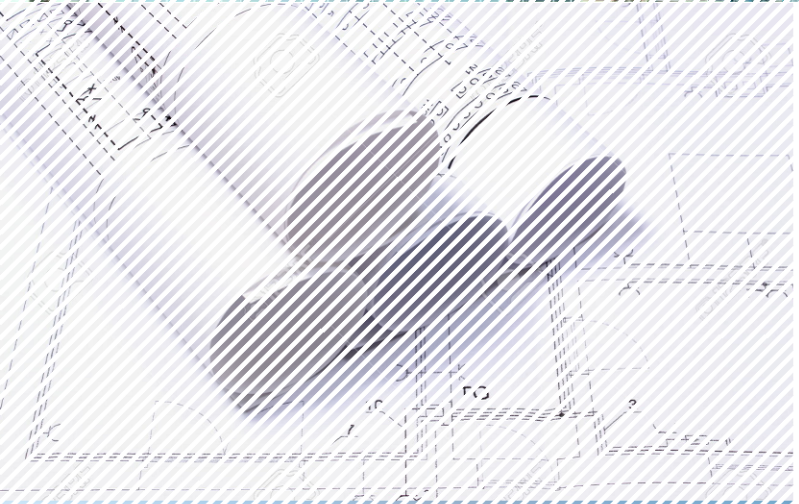


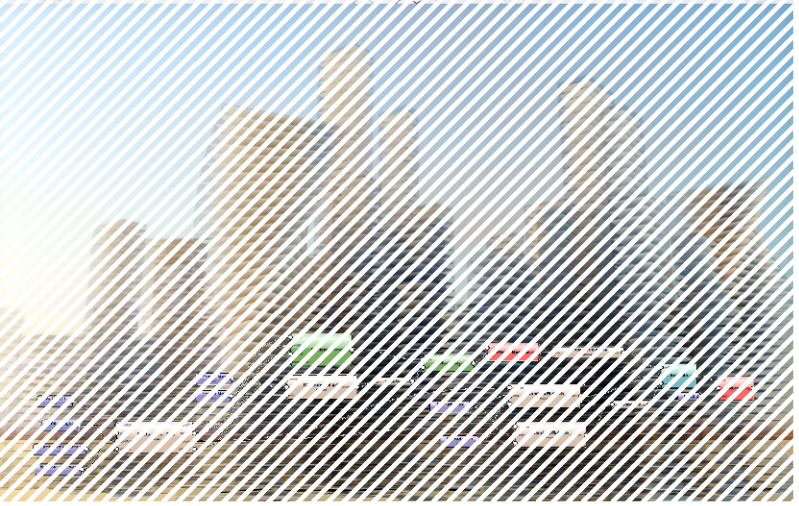
Kind of BIM		Concept	Design Intent	Constructability	Fabrication	Operations
Phase		Pre-design through Schematic Design	Schematic Design through Construction Docs	Construction (General Contractor)	Construction (Subcontractor)	Post-construction
LOD (United States)		100	300	350	400	N/A
Description		This 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, reinforcing 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; 5D Budgets	Shop models and drawings; output to robotic fabrication	Work Orders; Maintenance schedules; invoices; Trouble reports
Platforms						



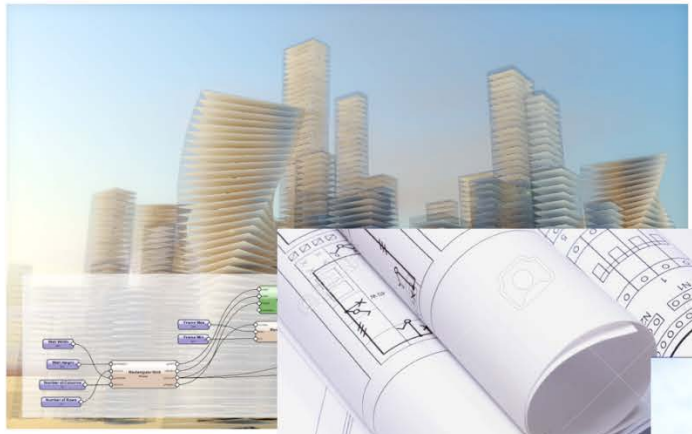




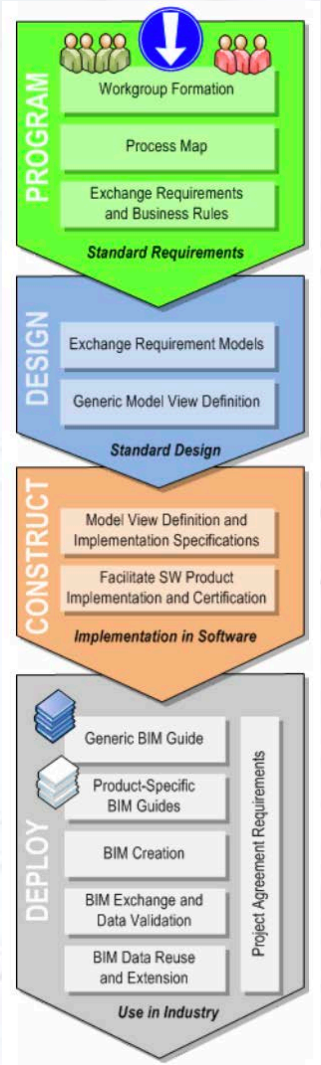




Kind of BIM		Concept	Design Intent	Constructability	Fabrication	Operations
Phase		Pre-design through Schematic Design	Schematic Design through Construction Docs	Construction (General Contractor)	Construction (Subcontractor)	Post-construction
LOD (United States)		100	300	350	400	N/A
Description		This 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, reinforcing 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; 5D Budgets	Shop models and drawings; output to robotic fabrication	Work Orders; Maintenance schedules; Invoices; Trouble reports
Platforms						

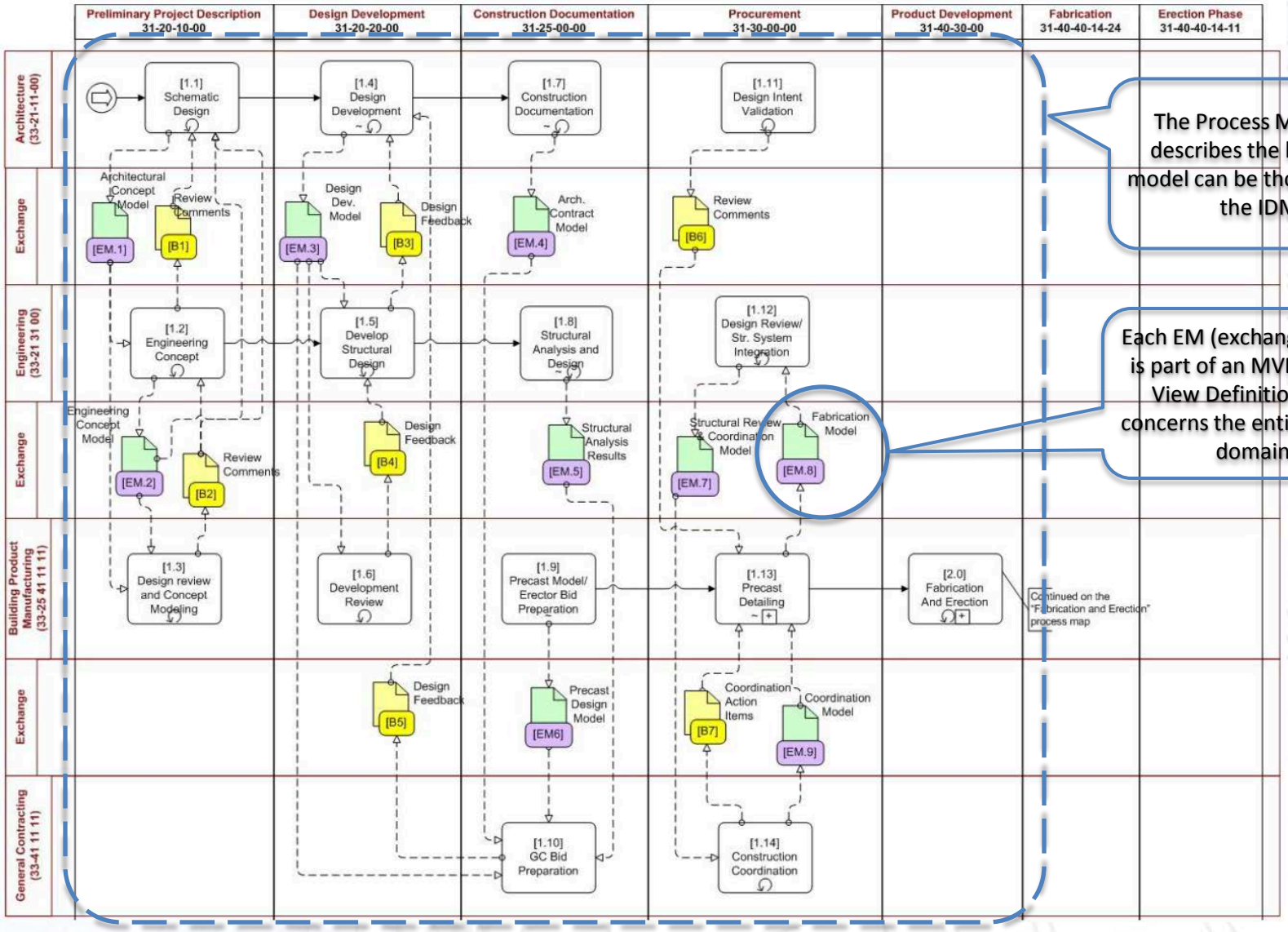


Established National BIM Standard Process (the “chevrons˝)



- 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

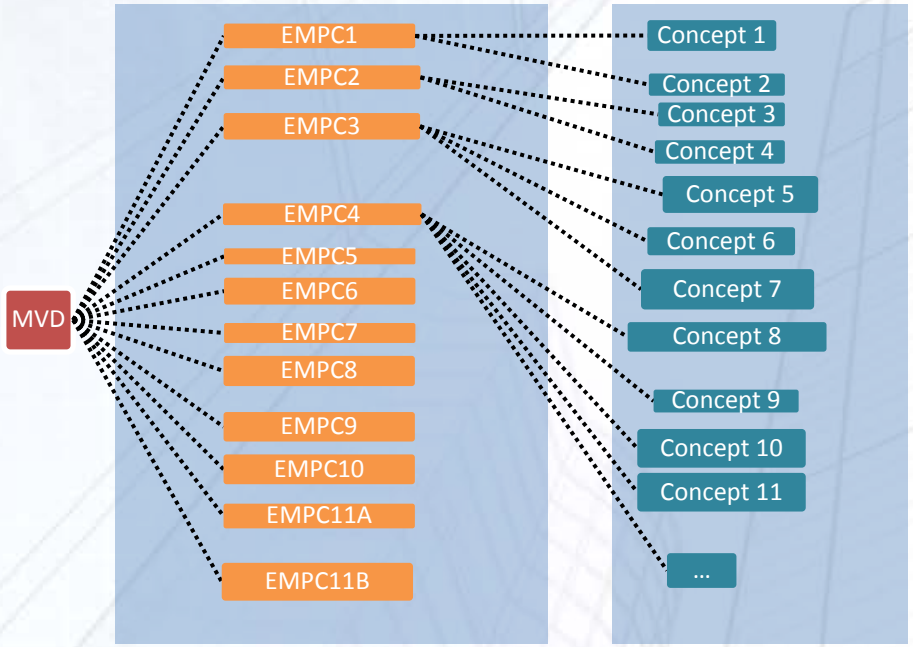


The Process Map that describes the business model can be thought of as the IDM

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

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		
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
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						
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

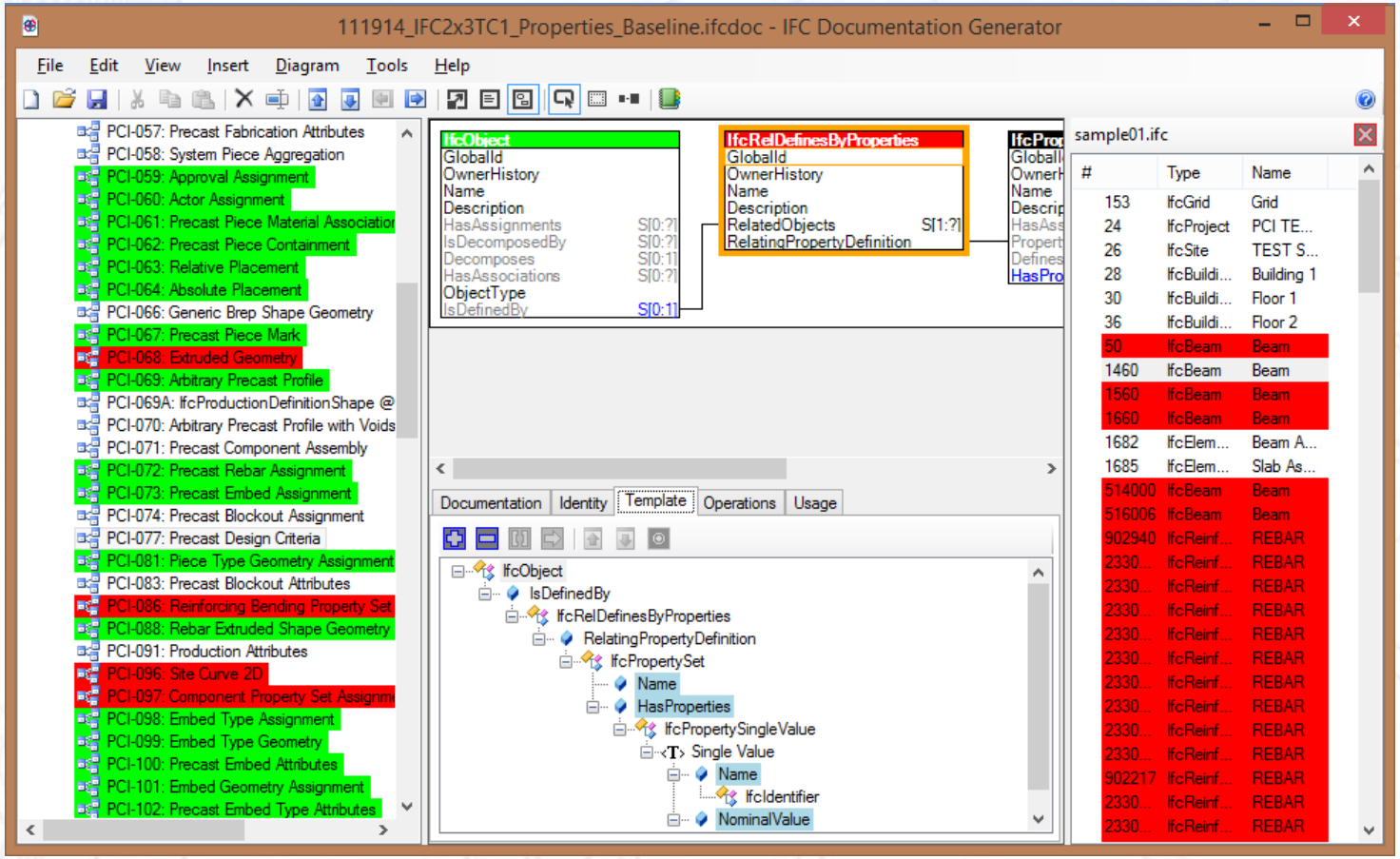
Successful Examples of National BIM Standards

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

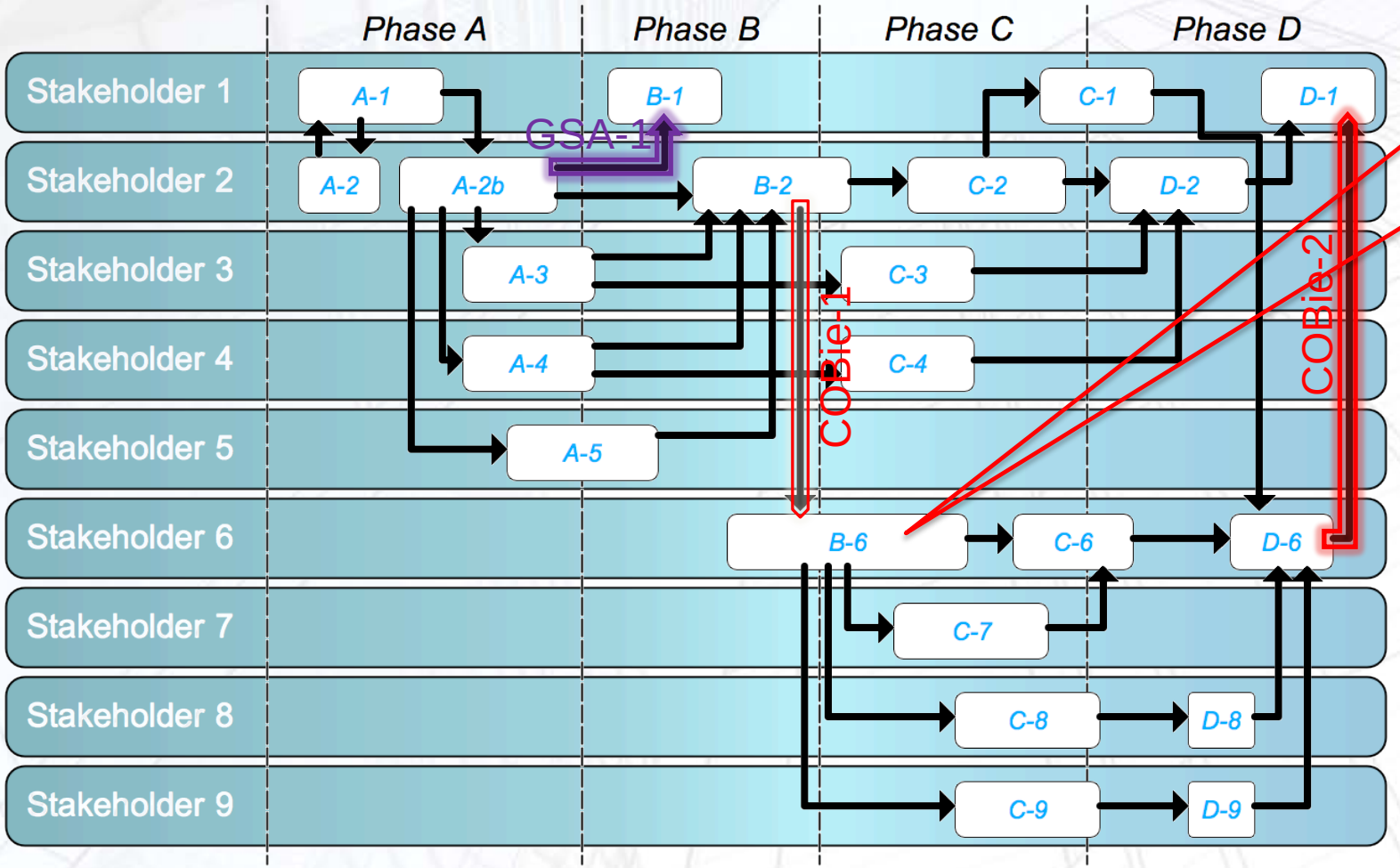
- AISC EM-11 Final Steel Detailing Model
  - Georgia Tech
  - Fiatech
  - AISC

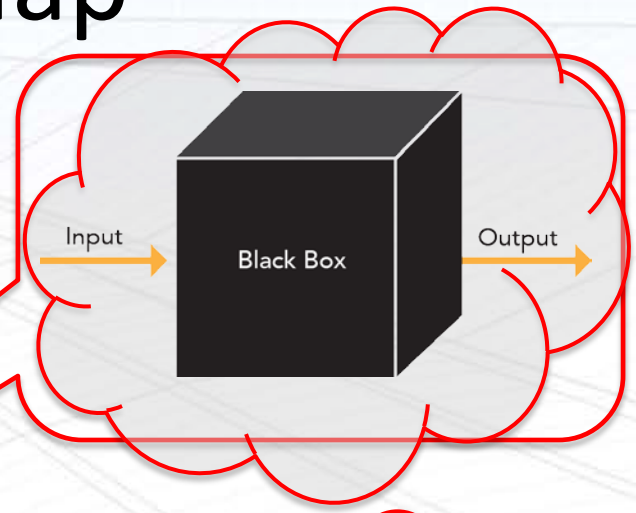
New(ish) Tools for Optimizing the Process: IFCdoc

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

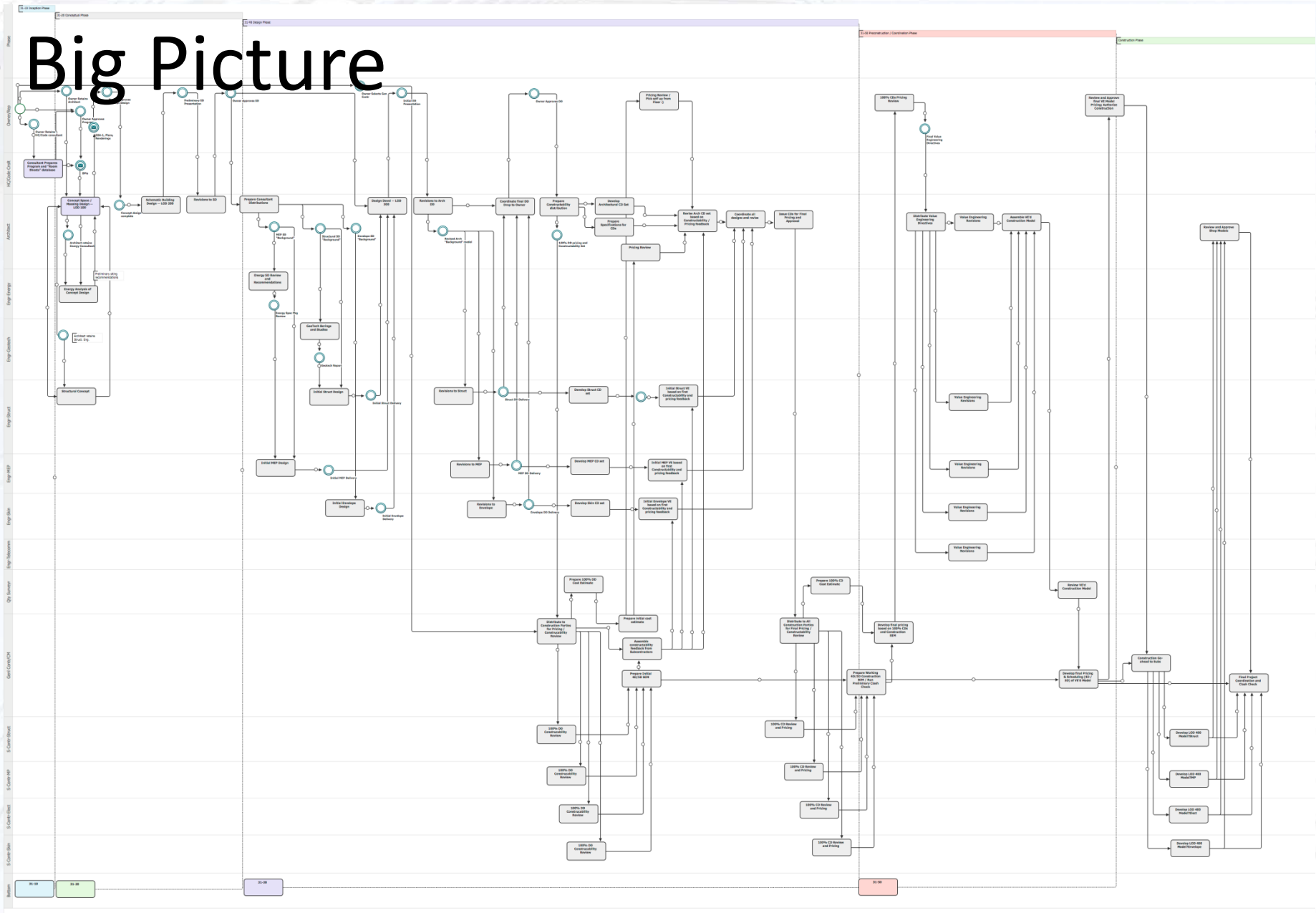


Swim Lane Diagram as Process Map





The Big Picture



BUILDING INNOVATION 2017
National Institute of BUILDING SCIENCES
CONFERENCE & EXPO

This concludes The American Institute of Architects
Continuing Education Systems Course

Robert Anderson

randerson@vectorworks.net

VECTORWORKS
A NEMETSCHEK COMPANY

CONTINUING EDUCATION AIA