



ID: **TH204**

Title: **Harnessing the Technology Innovation Revolution**

Date: Thursday, June 21, 2018

Time: 7:30 AM to 9:00 AM

LU: 1.5 LUs / RIBA

Program Summary

This is a must attend event for any architect. Innovative technology surrounds us: BIM, geo-spatial platforms, and big data and analysis, to name just a few. This session will enable you to interact with industry expert panelists and create your own strategic plan for implementing—and benefiting from—these technologies in your firm's work and in your professional life.

Leading architects and technologists are demonstrating dramatically new ways to impact new construction, architectural practices, and the global environment. See for yourself how innovation and entrepreneurship are changing the landscape via a mix of case studies, interactive discussions, and expert presentations. You'll leave this session with a handful of new opportunities and a plan to capitalize on them.

Learning Objectives

- A. Participants will establish and prioritize the top 3 or 4 emerging technologies.
- B. Participants will be able to understand what path-breaking and leading firms are doing to dramatically improve outcomes....
- C. Participants will be able to understand how the built environment, form and function of architecture, and everything from small components to entire buildings to regions and urban scale can be dramatically improved by new emerging technologies-....
- D. Participants will be able to take key ideas back to the office on Monday and create their own Innovative Technology Execution Plans

Speakers

Stephen Hagan FAIA
President | CEO, Hagan Technologies, LLC
Principal, Construction Data Ventures

Kimon Onuma FAIA
President, Onuma, Inc.

Jonathan Widney
Principal, Construction Data Ventures

Steve Jones
Senior Director, Dodge Data & Analytics

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Harness the Technology Innovation Revolution

Course Number TH204

Thursday, June 21, 2018, 7:30 AM – 9:00 AM

Learning Units 1.5 LU RIBA

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June 21-23, New York City

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Acknowledgements/Credits

Onuma Inc

BIMStorm

Hagan Technologies LLC

Construction.com

Construction Data Ventures LLC

Jeff Gravatte and CADD Micro

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Course / Learning Objectives

1. Upon completion, participants will be able to establish and prioritize the top 3 or 4 emerging technologies that interest them and their firms and pose great opportunities for the future of their practice. These innovative technologies enable the architect and architectural practice to increase the value of the built environment in terms of safety, occupant comfort and well-being, often using data and technology feedback for human-centric and experiential design processes.

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Course / Learning Objectives

2. Upon completion, participants will be able to understand what path-breaking and leading firms are doing to dramatically improve outcomes and provide innovative services to their clients and customers. These firms have transformed their practices through the immersive use of these innovative technologies and processes, thereby increasing productivity and profitability, in addition to improving building systems, materials and methods, as well as quality and integrative of design and construction documents and follow-on construction contract administration.

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Course / Learning Objectives

3. Upon completion, participants will be able to understand how the built environment, form and function of architecture, and everything from small components to entire buildings to regions and urban scale can be dramatically improved by new emerging technologies--whether it is wearable computing, cloud computing, or big data. A special focus of the presentations and interaction with attendees will be on critical building systems, materials and methods, as well as design and construction processes (codes and standards, environmental compliance, new as well as renovation and historic preservation).

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Course / Learning Objectives

4. Upon completion, participants will be able to take key ideas back to the office on Monday and create their own Innovative Technology Execution Plans for their in-house projects and firm-wide business planning. Included in the workshop is a workbook with exercises throughout the day and a process and strategy to create a personal Game-Changing Innovation Technology Execution Plan. Each attendee will select one or more of critical topic areas to address in their Execution Plan: Building systems, construction contract administration and documents, design (including urban planning), environmental and legal project constraints and opportunities, materials and methods, pre-design and historic preservation).

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Stephen R Hagan FAIA

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“ If you don’t change...you’re going to perish”

“If you want to survive, you’re going to change; if you don’t, you’re going to perish. It’s as simple as that.” — *Thom Mayne, FAIA, 2005 Pritzker Prize Winner*



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Game Changing Innovations

- What are Game Changing Innovations?
- Metrics | ROI are Key
- Focus on Data
- Game Changing Innovation Execution Plan
- AI Blockchain and the Future

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A Tsunami of Game Changing Innovations

Immersive Technologies

3D Printing
3D Reality Model
3D / Laser Scanning
4D Scheduling
Augmented Reality | Virtual Reality
Reality Capture

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A Tsunami of Game Changing Innovations

Internet Technologies

Cloud Computing
Cybersecurity
Fog Computer | Edge Computing
Geo-Spatial | GIS | Location
Sensors /Sensor Web
Mobile
Platforms | Platform as a Service
Software as a Service
Web Services

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A Tsunami of Game Changing Innovations

Machine / Computational Technologies

Artificial Intelligence | Machine Learning
Big Data | Analytics | Thick Data
Blockchain
Design Automation
Digital Fabrication
Drones
Internet of Things
Robotics
Pervasive Computing

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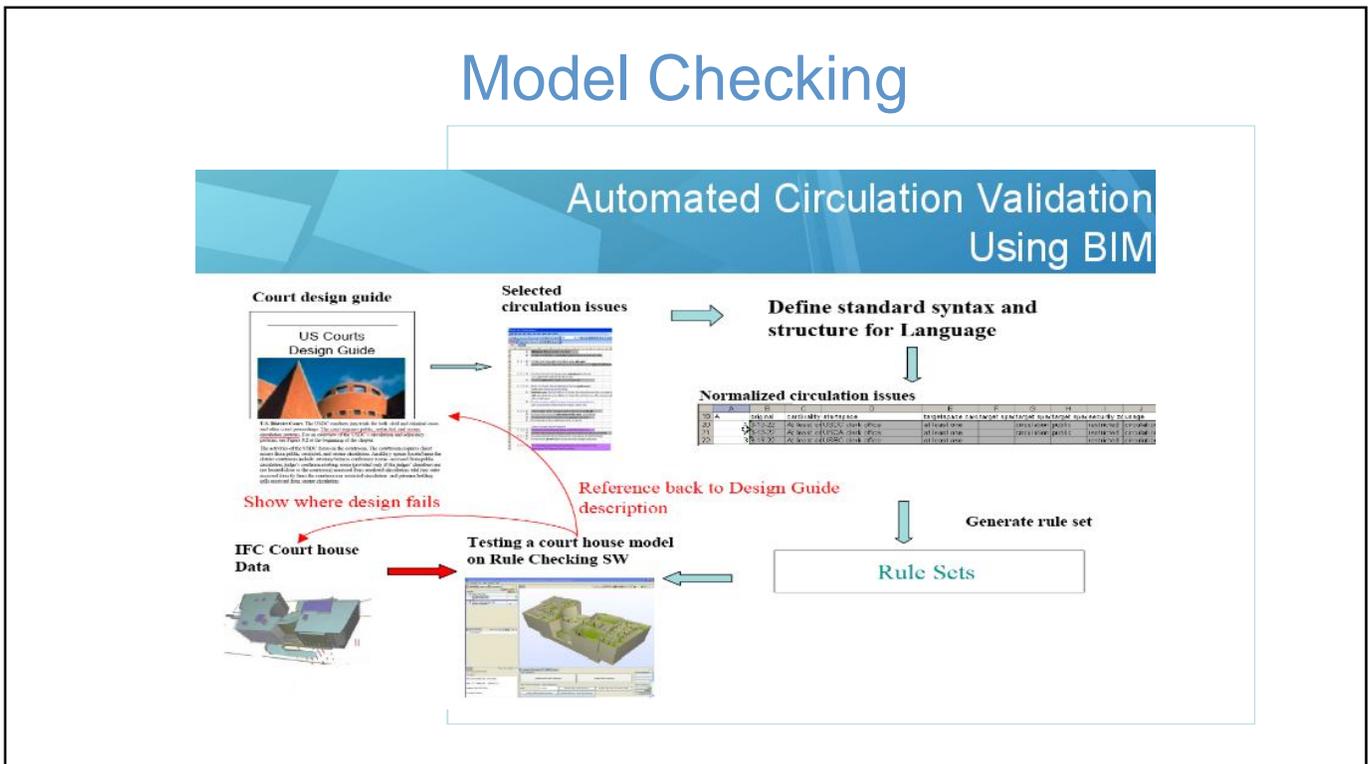
A Tsunami of Game Changing Innovations

Social Networking

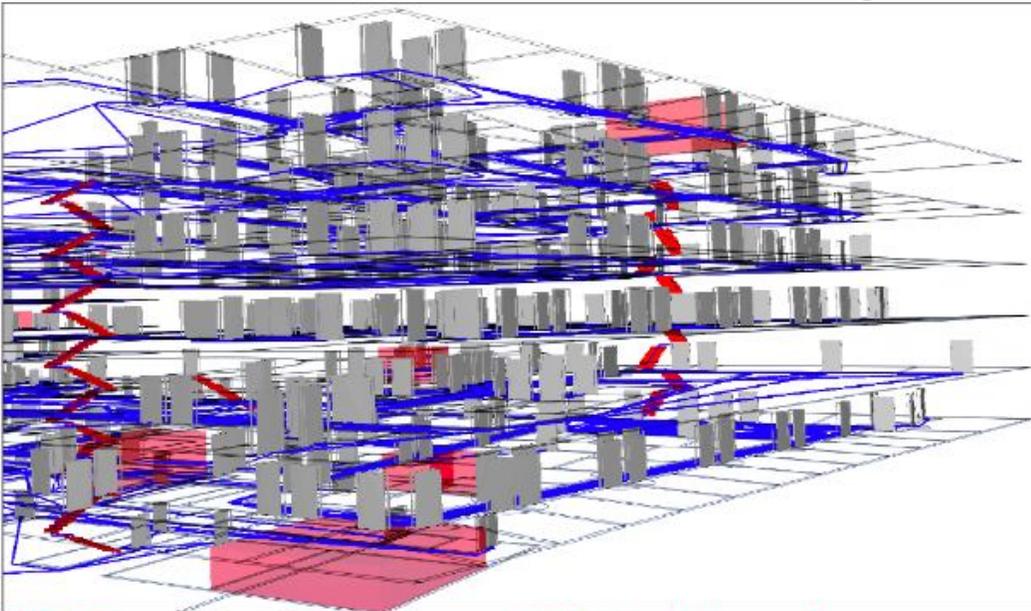
Social Networking and Media
Wearable Computing
Gamification
Crowd Sourcing

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Model Checking



27,000 routes were tested using **302 circulation rules** in approximately **20 seconds**.

3D Printing



10 ways 3D printing is disrupting the architecture industry

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3D Printing

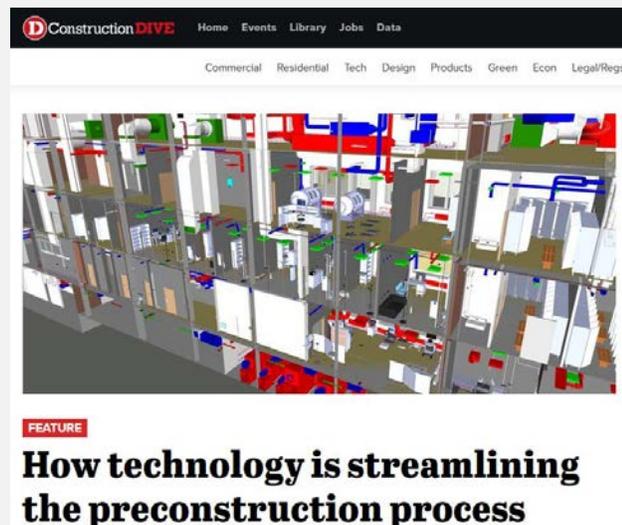


3D-printed bridge by Heijmans

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Contractors Are Out in Front

- Beck' Destini Estimator
- JBKnowledge SmartBid
- Assemble
- iSQFT
- DotProduct
- ProCore
- Autodesk BIM 360



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BlockChain and Virtual Reality



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Mobile/Cloud/Shared Data



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Mobile/Cloud/Shared Data

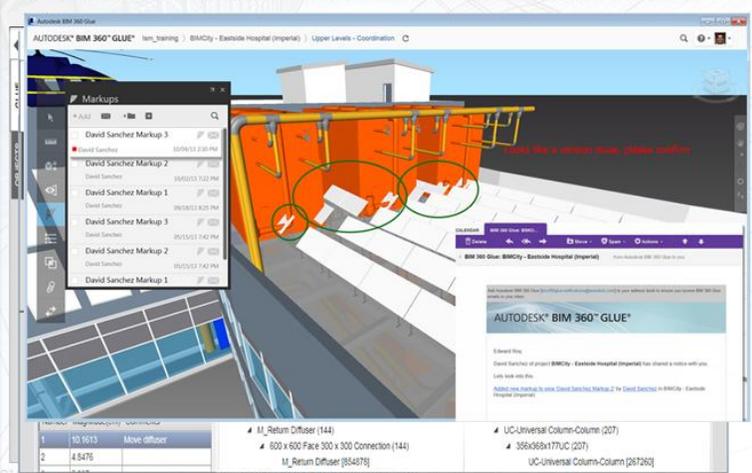


JE Dunn estimated **127,000** hours to post and draw documents manually on this project. At **\$79** per hour, it would have added an astounding **\$10,058,017** in paper-related costs.

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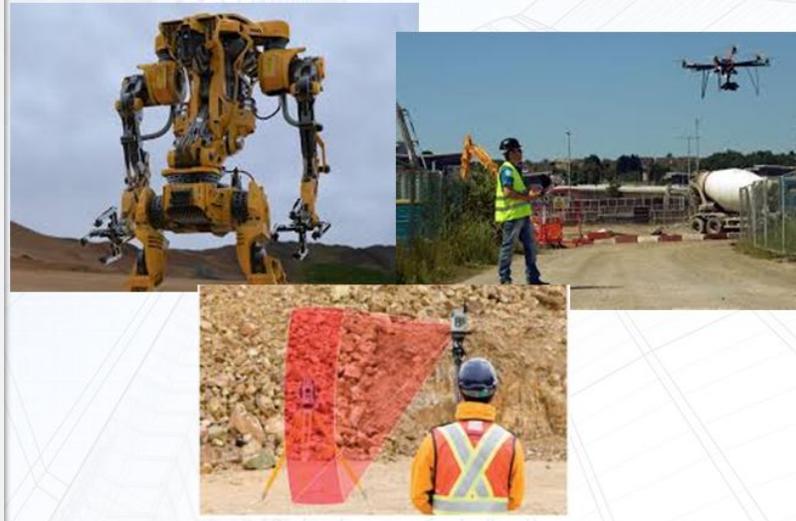
Mobile/Cloud/Shared Data

"All projects have 'conflicts' — things that don't conform or need changing," he said. "We can blow through \$100,000 in a major problem in about 5 minutes. Rich Kahn- Mortenson Construction"



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Robots / Drones / Lasers



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Robots / Drones / Lasers



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Robots / Drones / Lasers



3,000 bricks per day machine/ 500 bricks per day human

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Laser Scanning | Drones to Save Antiquities

Hope for Palmyra's Future

After Islamic State retreated last month, a plan to rebuild an ancient city



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VR and AR are Powerful for Architects

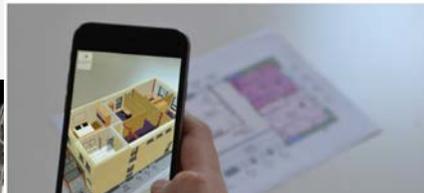
This Architecture Firm Is Turning VR Into The Next Great Productivity Tool



Three Augmented and Virtual Reality Apps for Design and Construction

Step inside your CAD and BIM models with new software for mobile devices.

By HALLIE BUSTIK



Apple's Next Big Thing: Augmented Reality

CEO Tim Cook is betting on augmented reality, a cousin of VR that he believes will keep his company on top and may even supplant the iPhone.

by Mark Gurman
March 20, 2017, 6:00 AM EDT

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Artificial Intelligence / Machine Learning

Embracing artificial intelligence in architecture



In recent years, technology and automation in architecture have soared. But not all architects have taken advantage of emerging technologies, and there is a growing sense that if firms don't incorporate artificial intelligence into practice, they'll get left behind.

[Read more >](#)

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Architecture of the Future

Manuel Jimenez Garcia and Gilles Retsin are literally setting the foundations for an architecture of the future. They are co-founders of the Design Computation Lab at [The Bartlett School of Architecture, University College London](#), where they work with students to speculate how digitalization, automation and robotics are transforming our built environment.



[More Videos](#)

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2004 – 2018 AIA TAP Building Connections Congress – Future of Design

Building Connections Congress 2018

[Register Now](#)

When: Jan 8, 2018 from 8:30 AM to 5:00 PM (ET)
Associated with [Technology in Architectural Practice](#)



The Future of Design 8
TAP Building Connections Congress 2018

Artificial Intelligence

Randy Deutsch, AIA, associate director for graduate studies at the University of Illinois at Urbana-Champaign School of Architecture:

"We're soon going to see super intelligence enter just about every sector, market, and field," he says. "It would behoove architects to imagine that it's going to enter our field, and we have the opportunity now to do something about it, to look at ways it can actually improve what we're doing and make us more profitable as practitioners as opposed to being victim to somebody else taking it and running with it."

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BIM (and Innovative Technologies) Execution Planning



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BIM (and Innovative Technologies) Execution Planning

- **Team Building:** Either with a project team or within a firm, gather stakeholders and discuss the goals of the plan
- **Educate:** Present a range of technologies such as the ones listed in this course. Discuss both concepts and case studies
- Discuss how **3 or 4 of these technologies** can be the initial focus for a project or for a firm's digital and innovative transformation
- **Make a specific action plan**, including goals, objectives, and tasks and a timetable to complete them
- **Award all participants** a certificate as an AEC Game Changer!
- **Iterate** as New Stakeholders Join the Project Lifecycle

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Are YOU an AECGameChanger?

GAME-CHANGING INNOVATION FlipBoard http://flip.it/_T5b84



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American Institute of Architects

Report on integrated practice

10 Information for the facility life cycle

2006

Kristine K. Fallon FAIA
 Kristine K. Fallon Associates, Inc., Chicago, IL

Stephen R. Hagan FAIA
 U.S. General Services Administration, Washington, D.C.



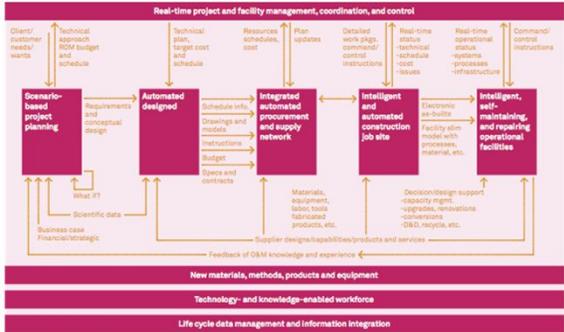


Figure 1
 The RITECH Capital Projects Technology Roadmap Vision Model.
 (Source: RITECH, 2004)

Much work on these frameworks and process change diagrams remains to be done; much is well underway. What is notable and crucial for progress in this area is described in the excerpts of the Capital Facilities Information Handover Guide, Part 1, which follows: taxonomies, definitions, and the characterization of information are critical building blocks in the foundation of the Information for the Facility Life Cycle.

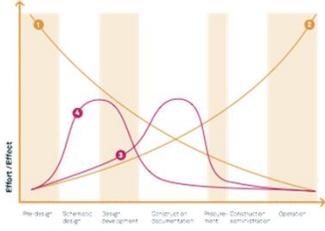


Figure 2
 Collaboration, integrated information, and the life cycle in building design, construction and operation.
 (Source: CUR, August 2004)

- Ability to impact cost and functional capabilities
- Cost of design changes
- Traditional design process
- Preferred design process

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Report on integrated practice

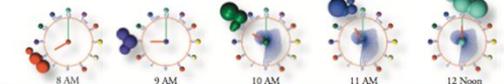
The twenty-first century practitioner

6

2006

Kimon G. Onuma AIA
 Onuma & Associates, Inc. and Associates, USA

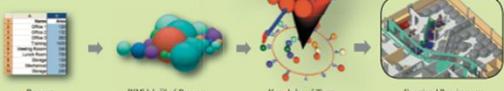




The Design Charette

- 8 am Start Project**
 - Client contacts pre-qualified team in project database to start brainstorming.
 - Site is identified on a Google Earth™ 3D model of the Boston area • 3D BIM model of programming requirements auto-generated and placed in Google Earth™ • Easement, lien, covenant and restriction database(s) checked • Data from historical office building BIM to be accessed through the project database.
- 9 am Site and GIS Review**
 - Confirm size of site and soil condition from GIS data in 2D and 3D • Rate each footprint location and pass data of conditions to structural analysis for foundation design • Automatically perform a preliminary code analysis by submitting the project to the city planning and zoning database • Rate distances to transportation and housing
- 10 am Architectural Review**
 - BIM review by team members who are assigned based on availability • Data from existing building analyzed • Potential schemes studied
- 11 am Mechanical, Electrical, Plumbing Review**
 - Determine systems and costs • Performance requirements defined • Recommend to pursue Silver LEED rating on manufacturing portion and Gold rating for the rest
- 12 pm Structural Review**
 - One plan includes a multi-story building, which triggers need for underground parking • Soil conditions from GIS dictate various foundation systems • Review long span requirements

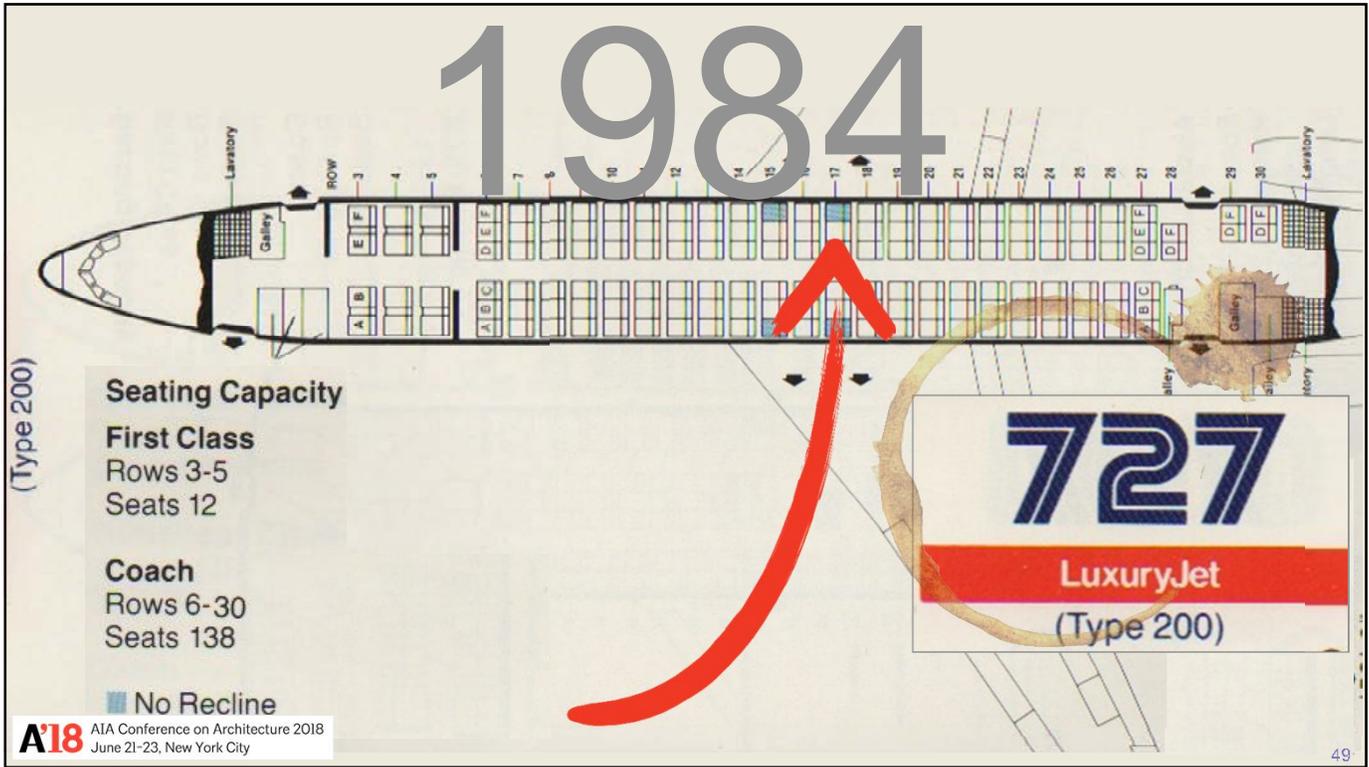
A view of the non-linear nature of time and effort of an 8-hour Charette. New processes and technology allow for instant access to all team members to the knowledge needed for the project. Each sphere represents activity and knowledge that accelerates throughout the day.



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The 21st Century Practitioner - Transformed by Process not Software - Kimon G. Onuma AIA

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ENDORSEMENTS/RESTRICTIONS (CARBON)		ORIGIN SALT LAKE	DESTINATION SALT LAKE	FROM/TO SLC	CARRIER				
NAME OF PASSENGER [REDACTED]		ISSUED IN EXCHANGE FOR	DATE OF ISSUE 8 APR 80	FLIGHT COUPON 3					
COUPONS NOT VALID BEFORE		ORIGINAL ISSUE	CARRIER	FORM & SERIAL NUMBER	AGENTS NUMBER				
COUPONS NOT VALID AFTER		TICKET DESIGNATOR	TOUR CODE						
X/O	GOOD FOR PASSAGE BETWEEN POINTS OUTLINED	FARE BASIS	ALLOW	CARRIER	FLIGHT/CLASS	DATE	TIME	STATUS	
	FROM SALT LAKE	YHG28		EA	845	17	APR 10	OK	
	TO ATLANTA	YHG28		EA	699	18	APR 6	OK	
	FROM ORLANDO	YHG28		EA	541	19	APR 12	OK	
	TO MIAMI	YHG28		EA	892	23	APR 8	OK	
	TO NEW YORK - LGA								
FARE	EQUIV. AMT. PD.	ROUTE CODE		ENCODE	CPN	AIRLINE CODE	FORM	SERIAL NUMBER	CK
369.00					3	00		1409006060	5
TAX	TOTAL								
29.52	398.52								

ATC-123

FROM/TO	CARRIER	FARE CALCULATION
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SUBJECT TO CONDITIONS OF CONTRACT ON PASSENGER'S COUPON

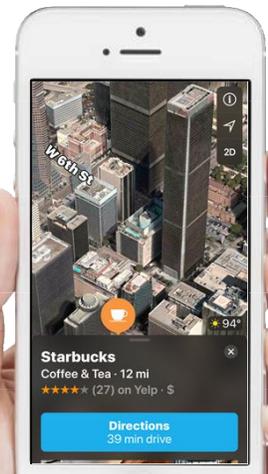
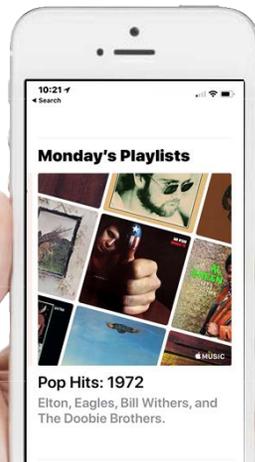
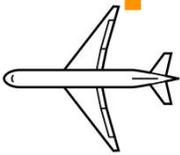
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More Buttons are Better..



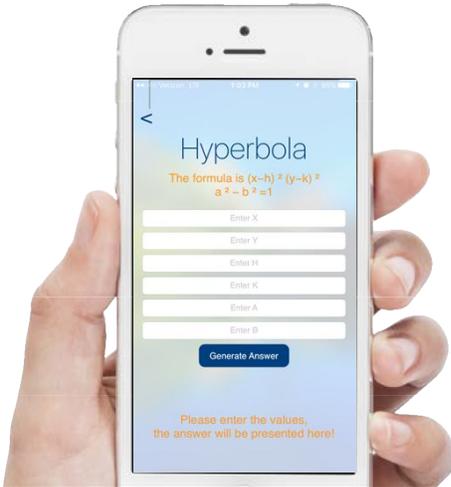
PLATFORM



It's easier than ever
to build software.
Software is now

a **commodity**.

<https://techcrunch.com/2018/03/27/data-is-not-the-new-oil/>



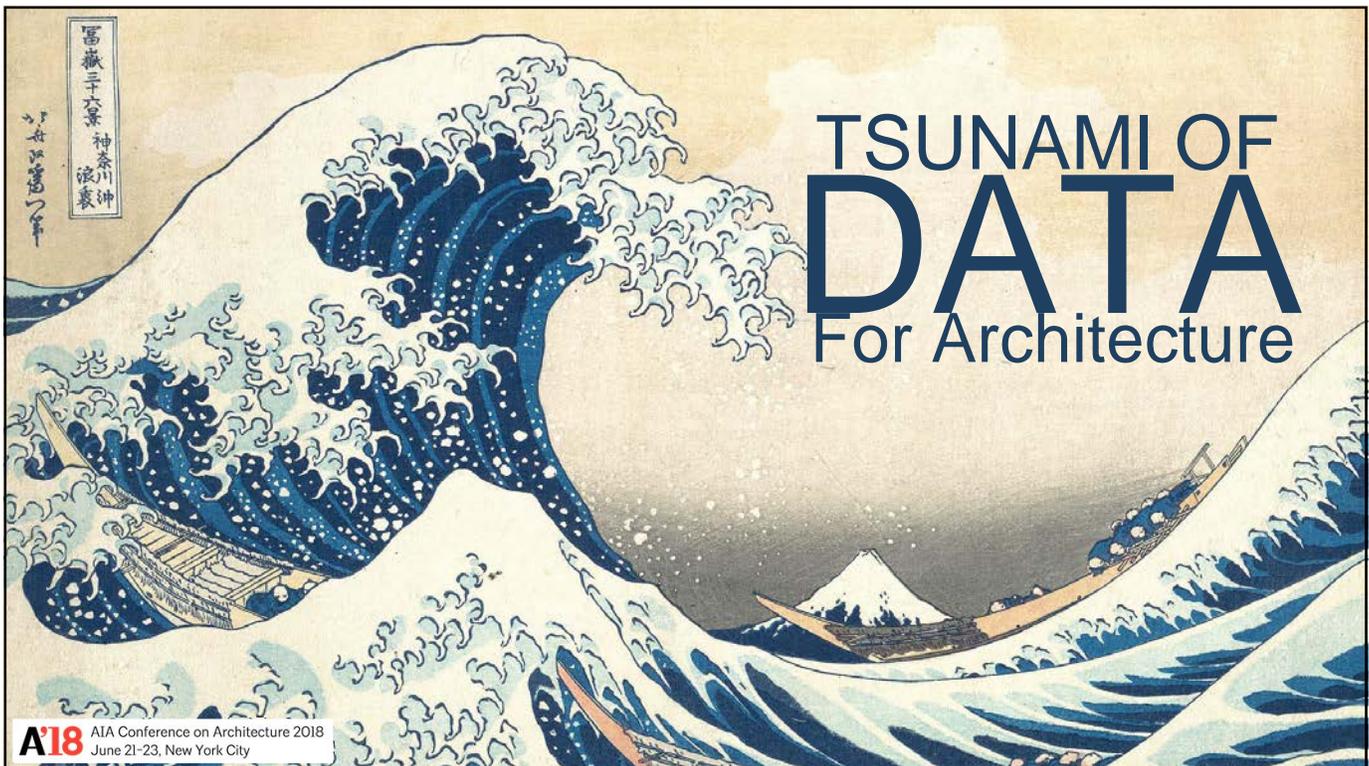
This 16-year-old kid fell behind in
math class, so he built an **app** to do it
for him

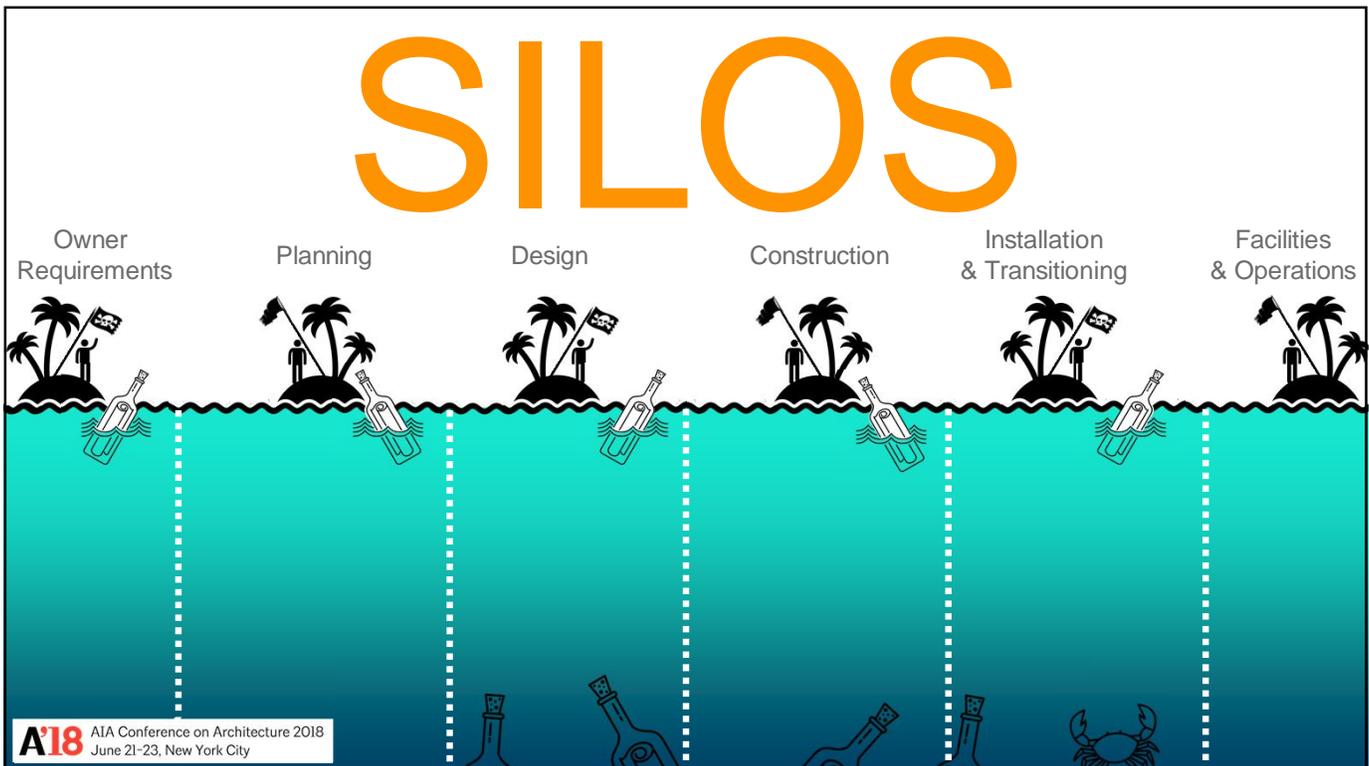
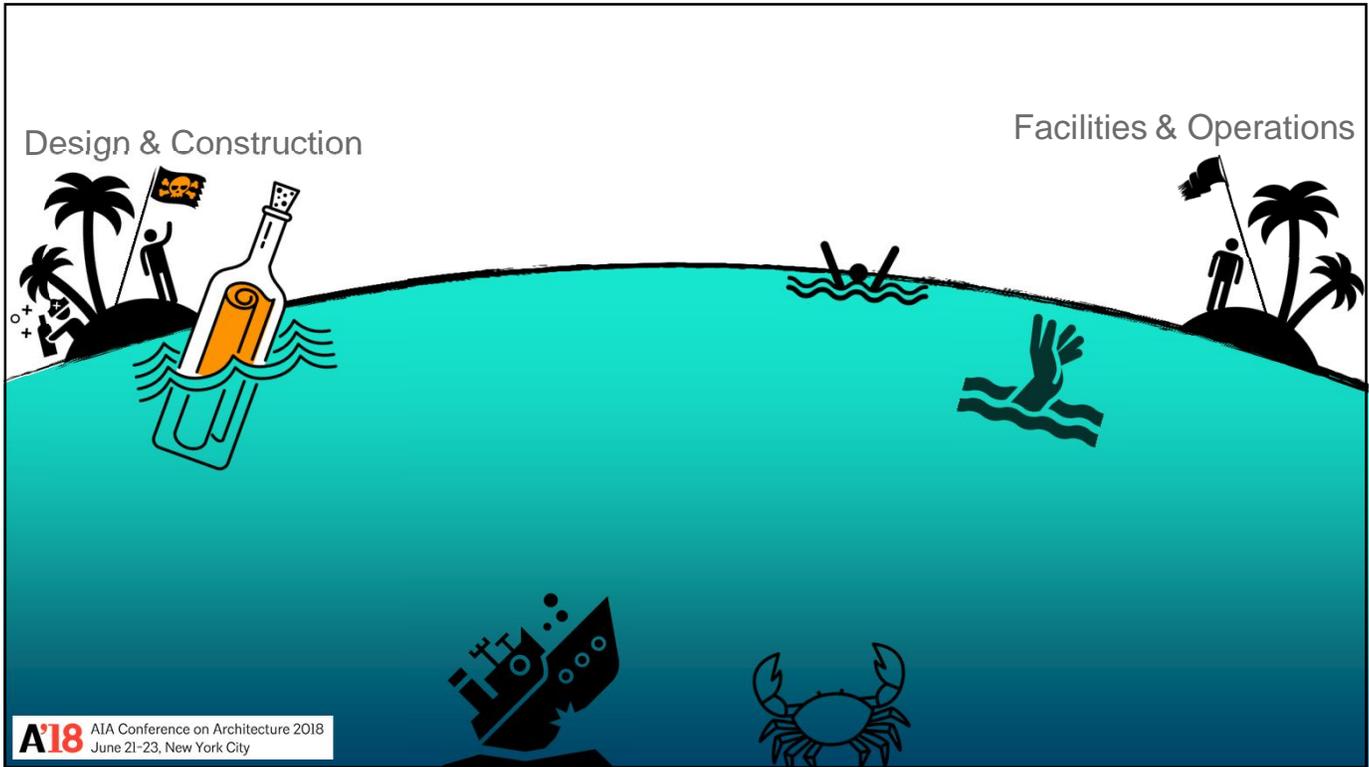
Oct. 5, 2016, 4:20 PM 56,727



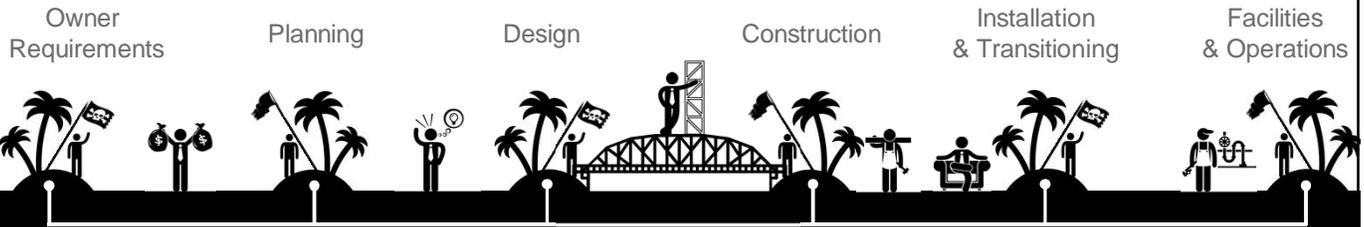
Amit Kalra

<http://www.businessinsider.com/amit-kalra-6284-calc-app-2016-10>





PLATFORMS



DIGITAL PLATFORM

DATA

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PLATFORMS



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Objects

~2,100 Objects
Used in Templates



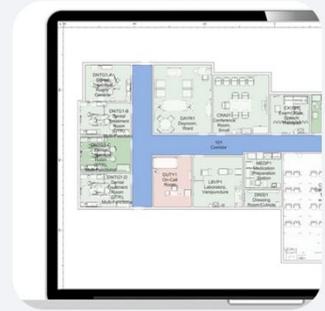
+ Templates

~1,100 Space Templates
Used in Departments



+ Departments

Multiple Departments
Used in Projects



= Projects

Generate Infinite Variations
for Facility Projects

SEPS2BIM PLATFORM

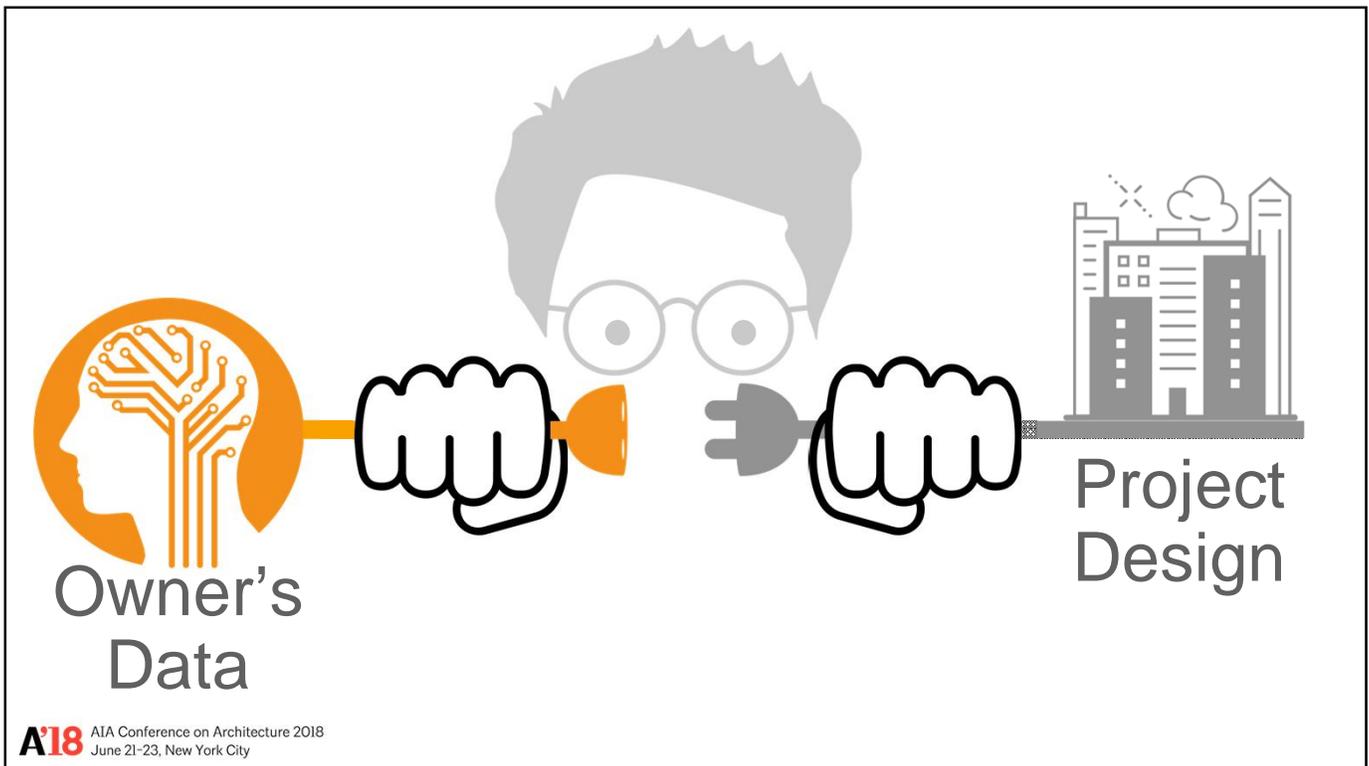
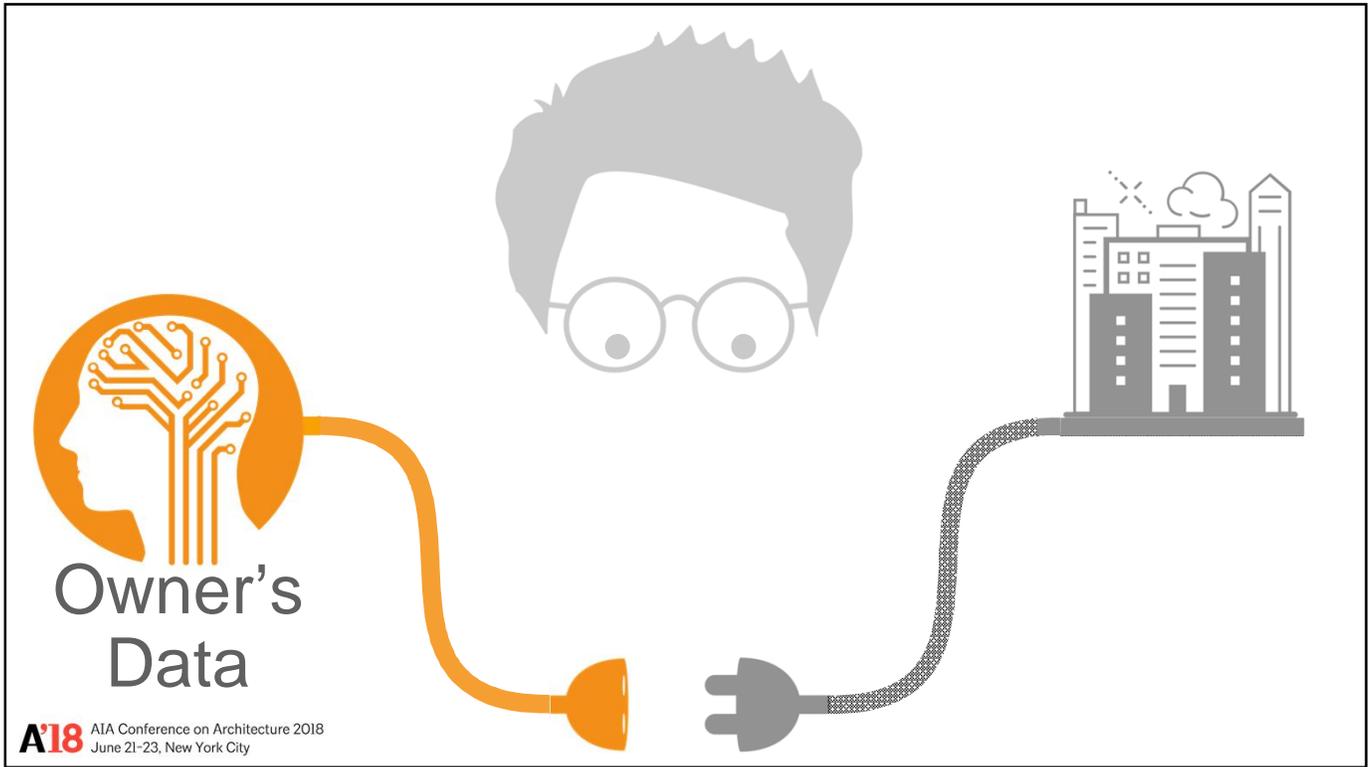
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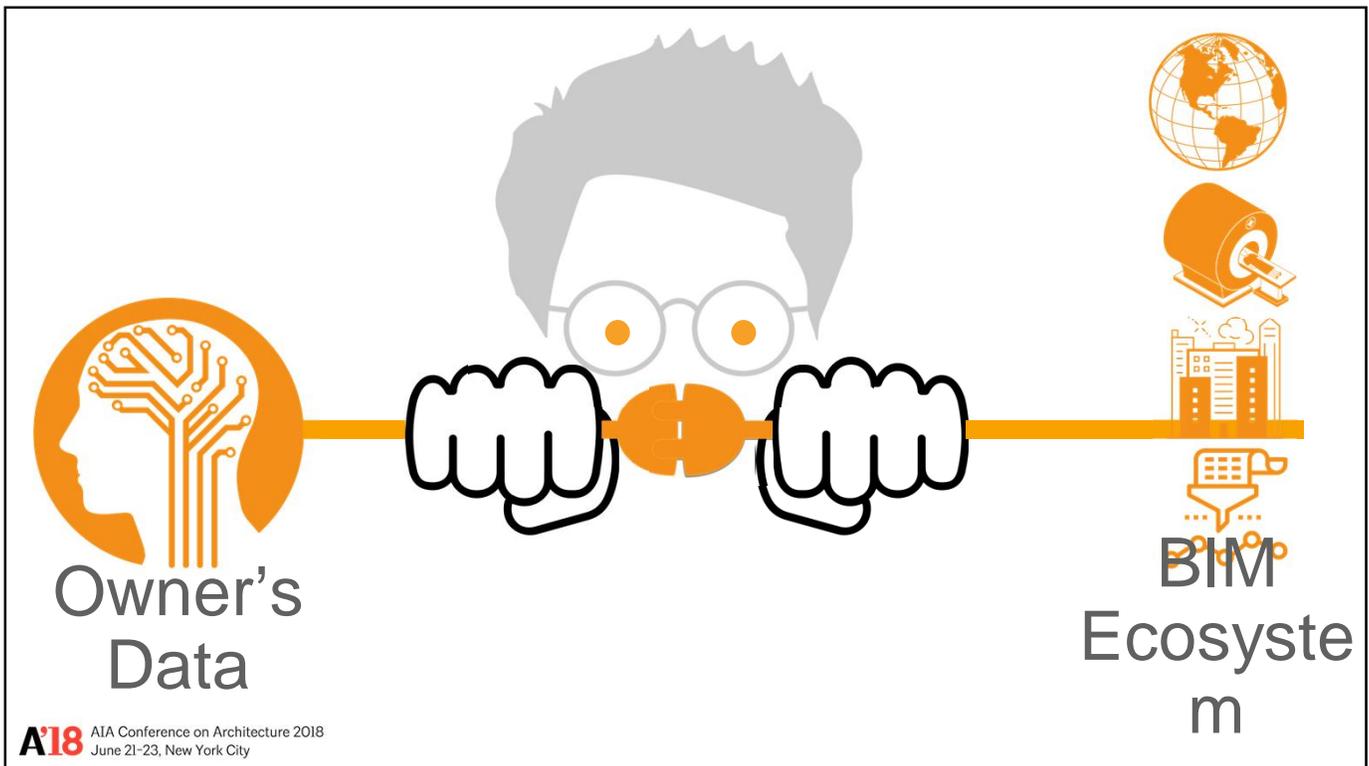
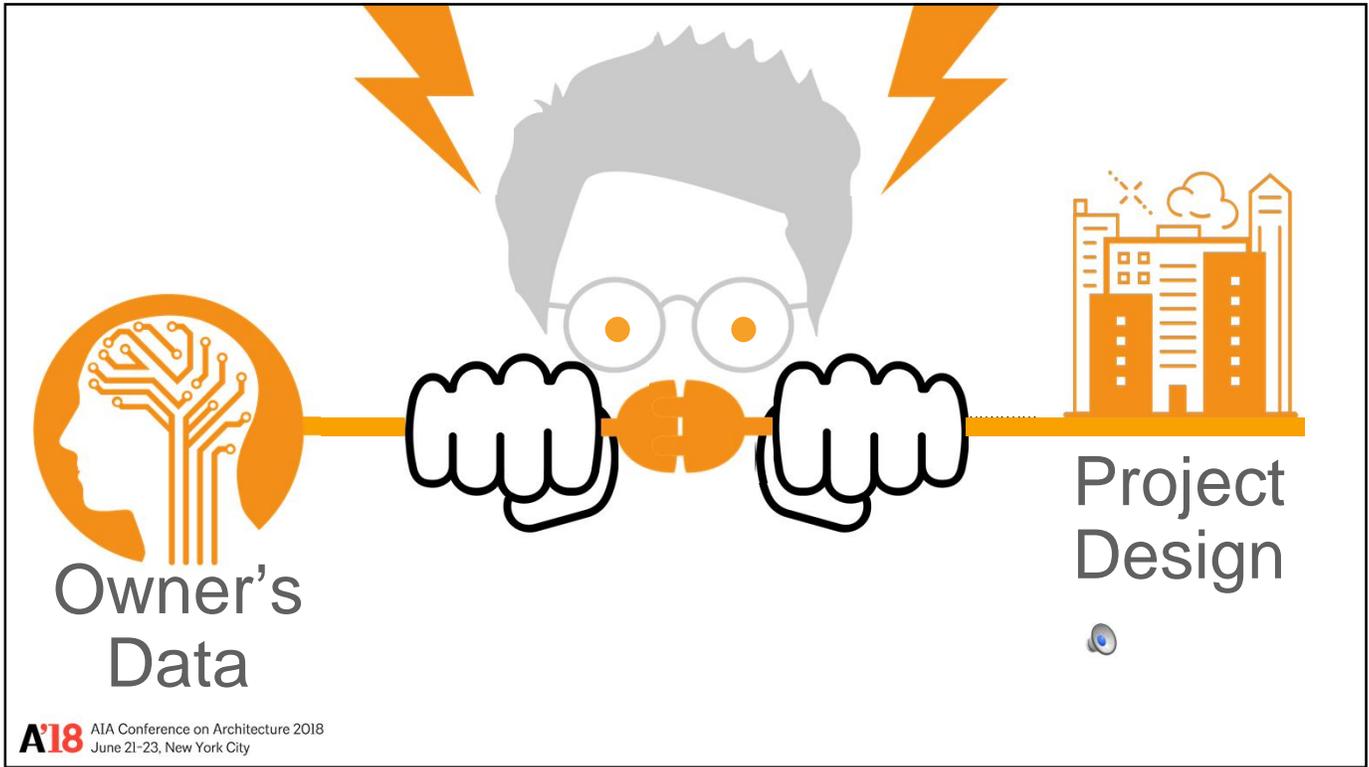
Data: Equipment, Criteria & More



**Owner's
Data**

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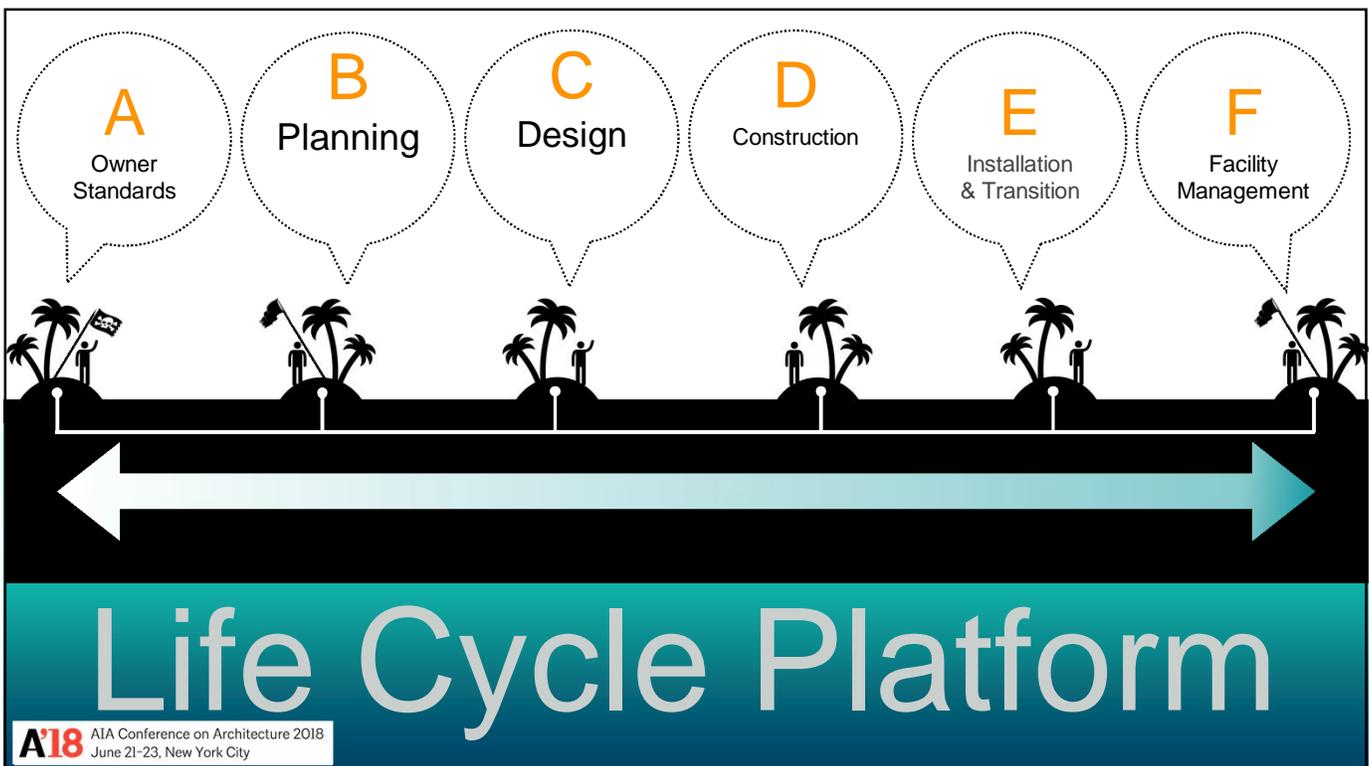


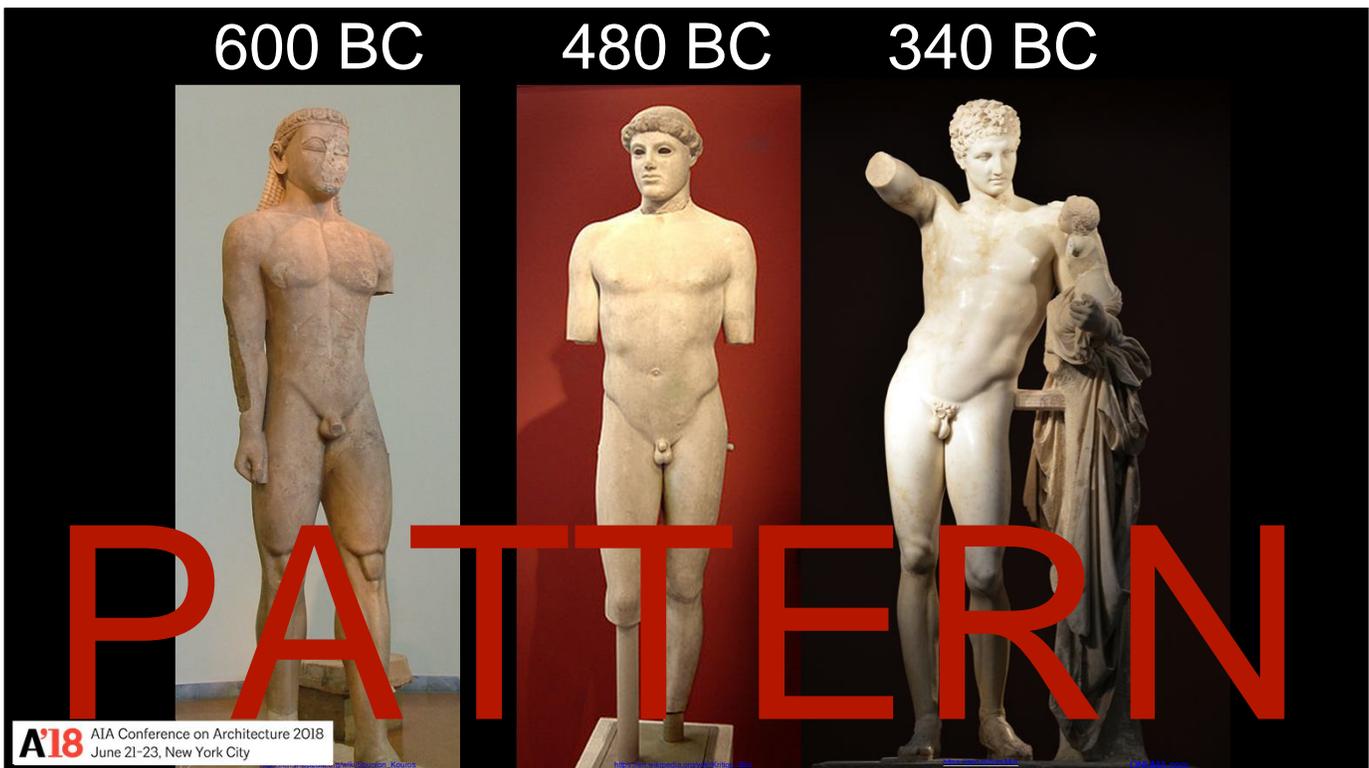
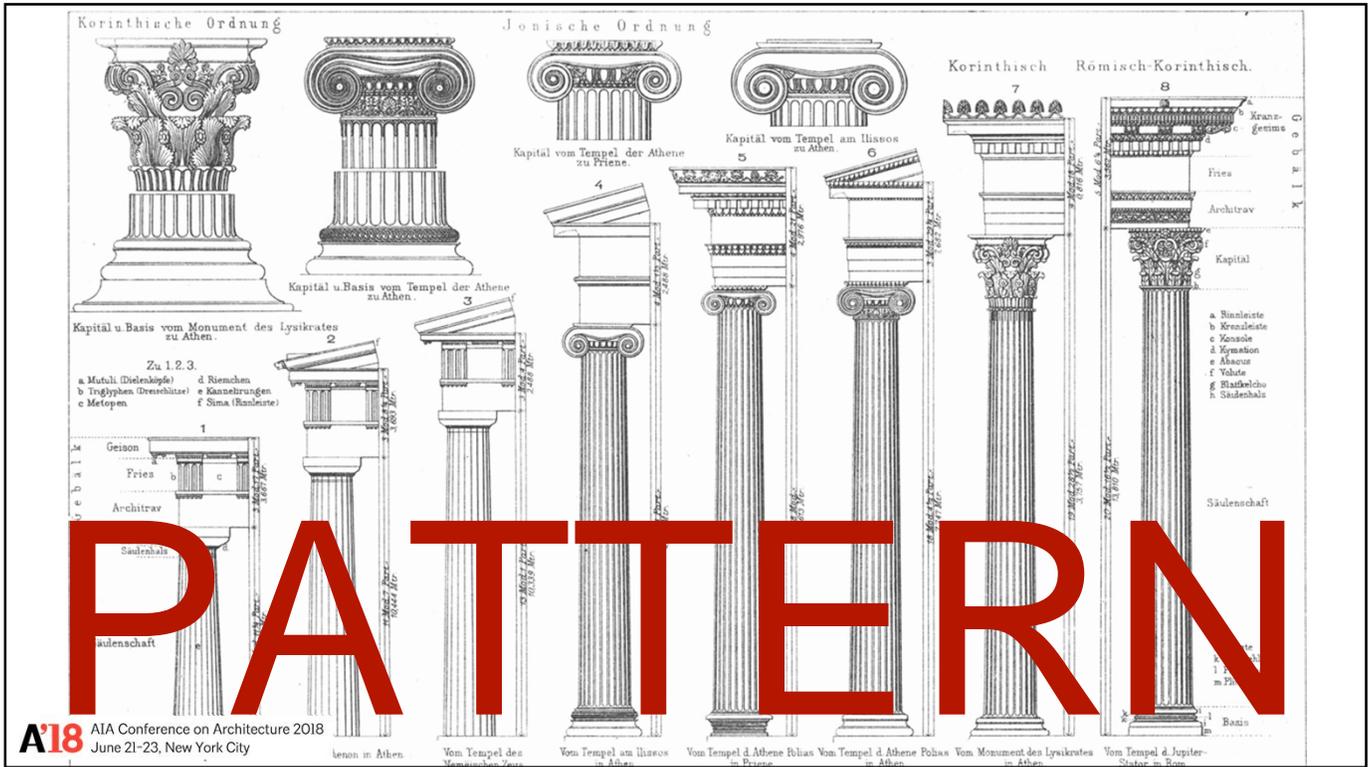


ECOSYSTEM

A healthy ecosystem does not have an end date, it just supports itself and adjusts to change.

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TH403 6/21/2018 9:45 AM - 11:15 AM

ARCHITECTURE

AS A
PLATFORM

FOR THE NEW
URBAN
AGENDA

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Game Changers in Architectural Practice

A Discussion of Perspective & Observations

1. What is happening today within the AECO Sector?
2. Chaos, concern or confusion – what about confidence?
3. Adoption – what is really impacting the decision to change?
4. Evolution – why should we really change? What about risk?
5. Reality – why isn't there more DEMAND for higher Quality?

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Game Changers in Architectural Practice

A Discussion of Perspective & Observations

Observations from the past 25+ years and what has been done to try to make a difference. Discussion will include the practical application of current capabilities, specifically in the area of Measuring Design (Model) Quality and compliance with company, project or owner requirements. I will also touch on automation, while maintaining consistency. Finally, recognition that momentum is critical to industry adoption.

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Game Changers in Architectural Practice

Questions to ask Ourselves

1. Who is controlling the evolution of technology innovation?
2. What happened to commitment to continuous improvement?
3. What BIM Use Cases can be supported TODAY?
4. Introduction of logic and behavior 'checks' that are possible TODAY
5. Where are the bottlenecks that are impacting the potential of BIM workflows
6. Why is consistency of Quality not the #1 driver?

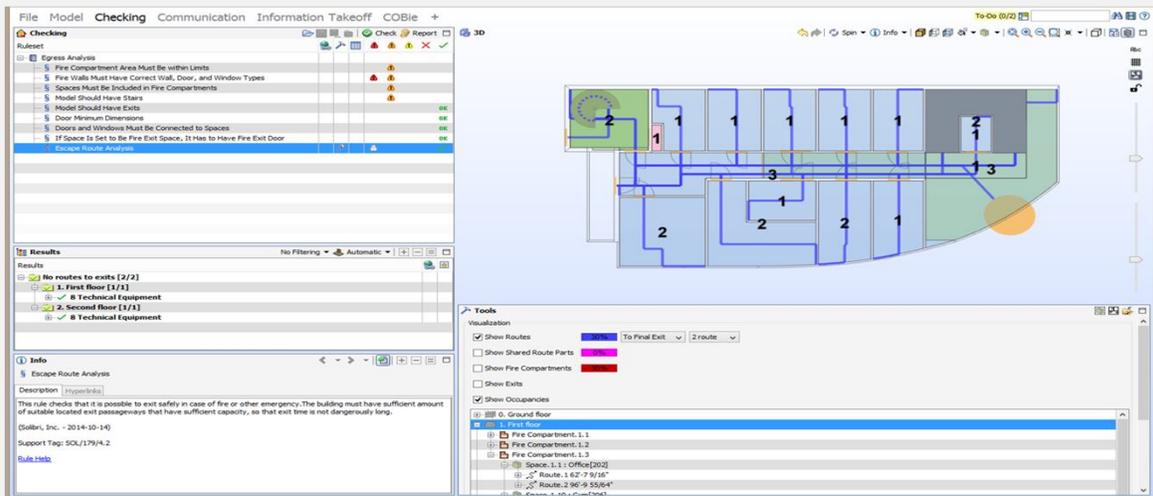
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BIM Use Cases – a Small Sampling

- Code Compliance
- Model QA/QC
- COBie
- LoD Verification
- Government Requirements
- Space Audits
- Coordination
- Site Safety
- Risk Management & Mitigation
- BIM Validation

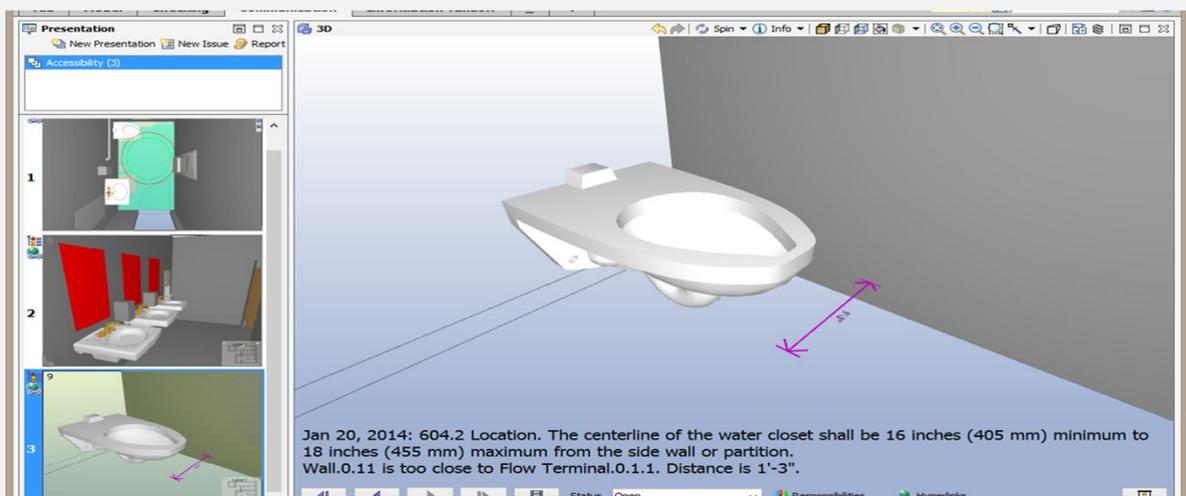
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Information at our Fingertips – TODAY Code Compliance - Occupancy and Egress



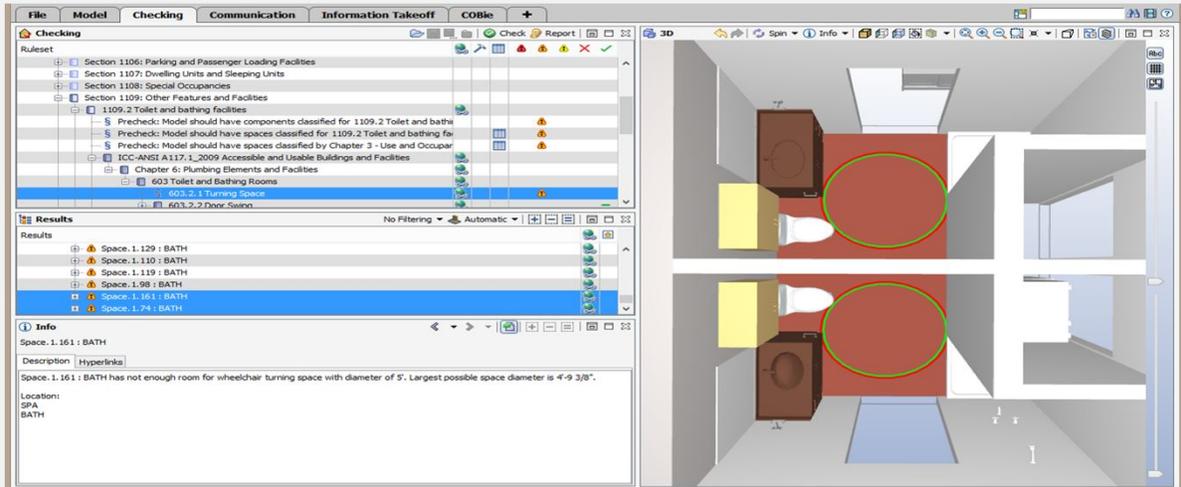
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Code Compliance – (604.2) Toilet Rooms



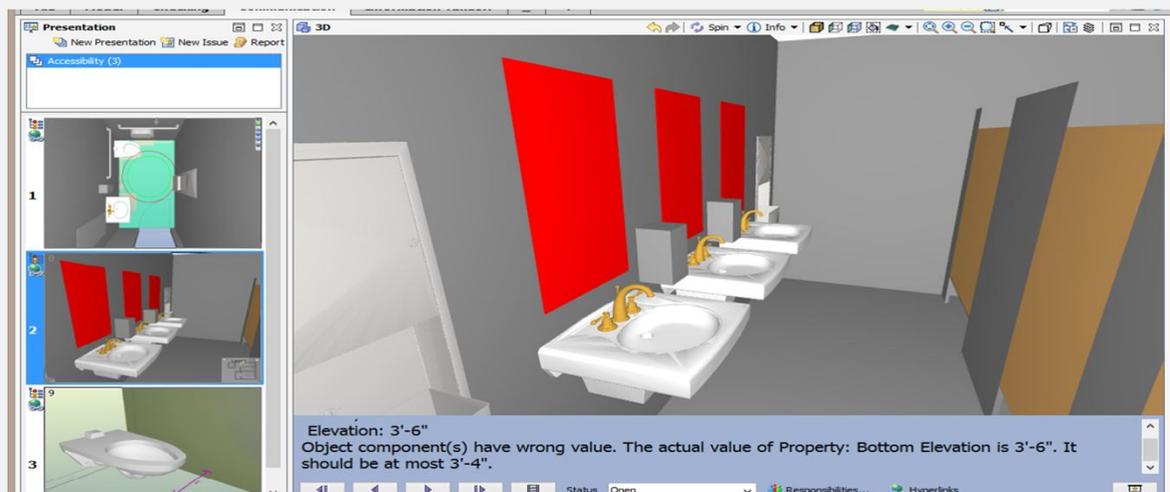
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Code Compliance: ADA



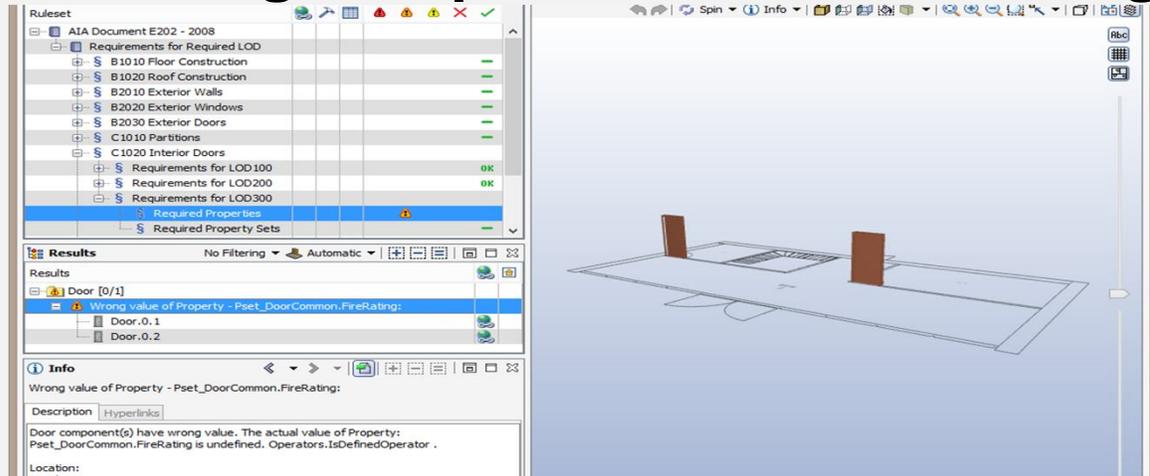
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Code Compliance: Mirror Heights



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LOD Measuring Compliance – No Fire Rating



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Area and Space Calculations Customized for the Owner or Project

Note: The perimeter of the *Usable Area* is defined according to the 'Standard Method for Measuring Floor Area in Office Buildings, ANSI/BOMA Z65.1-1996'.

There are two main properties associated with the *Usable Area Visualization* tool:

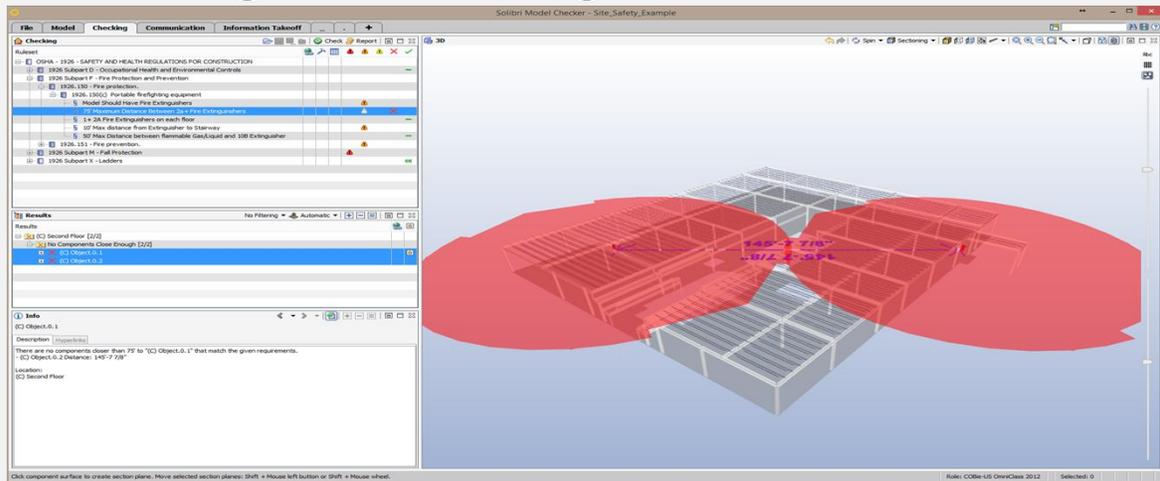
- 1) A set of three numbers: the first is the room number, the second is the *GSA BIM Area* in black, and the third is the *Usable Area* in red.
- 2) A dashed red line that shows the perimeter of the *Usable Area*. There is no dashed line to represent the *GSA BIM Area*.



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Safety

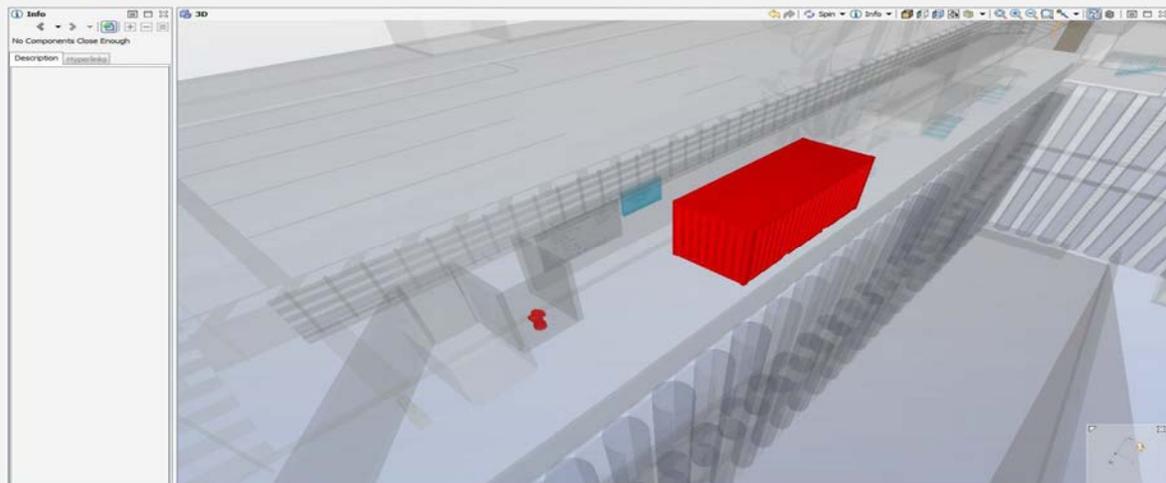
Ensuring Fire Extinguishers are Present



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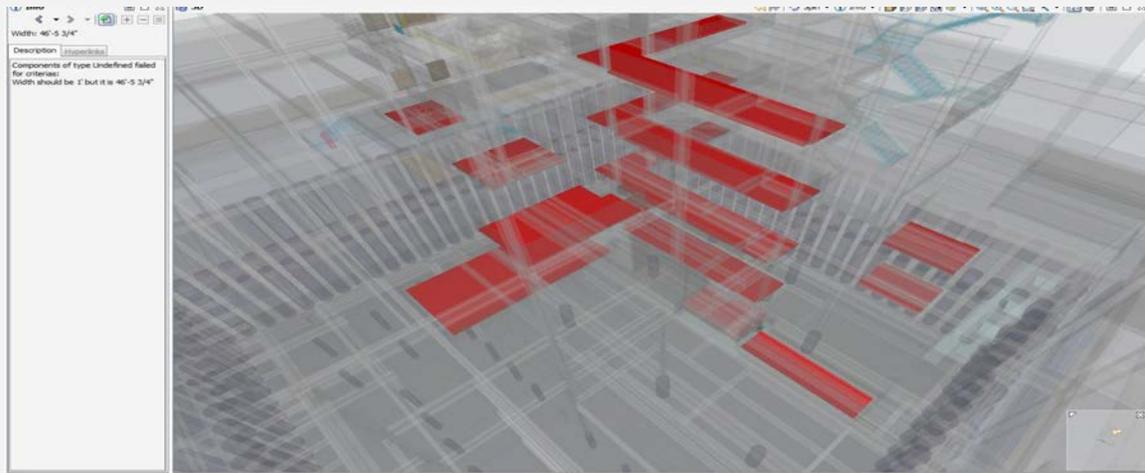
Safety

Material Storage Proximity to Hydrant



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Safety Modeled Slab Edge Protection



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Summary

- What are we waiting for?
- Innovation requires US to embrace change
- Evolution requires US to advance our Industry
- Better Model Consistency = Better ROI
- If we ask for it...they will develop it

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Steve Jones

Stephen Hagan FAIA

- President | CEO, Hagan Technologies
- Principal, Construction Data Ventures

Kimon Onuma FAIA

- President, Onuma, Inc.

Jonathan Widney

- Principal, Construction Data Ventures

Steve Jones

- Senior Director, Dodge Data & Analytics



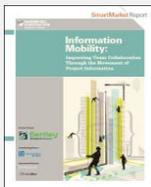
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Dodge Data & Analytics Research on Trends

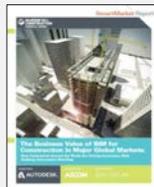
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TECHNOLOGY/INNOVATION

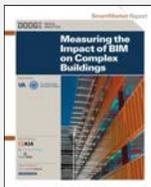
Information Mobility



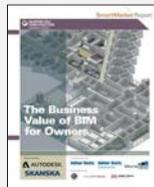
BIM for Contractors



Measuring BIM



BIM for Owners



SUSTAINABILITY

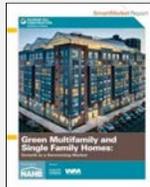
World Green Trends



Design for Health



Green Homes



Green Schools



PRACTICES/PROCESSES

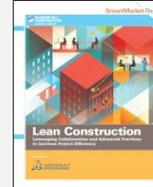
Managing Uncertainty



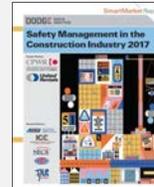
Project Delivery Systems



Lean



Safety (3x)



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- What are people doing that generates value*, improves outcomes**
 - **Meaningful, Reliable, Repeatable, Scalable*
 - ***How much better is it than previous methods?*
- What's keeping people from doing it (or doing more of it)?
- What do people believe will:
 - *Drive more use*
 - *Add more value*

What can/should people do to move forward?

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Harnessing the Technology Innovation Revolution

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The **NEW**

The **NEXT**

Harnessing:

Taking control of something powerful
and driving for results



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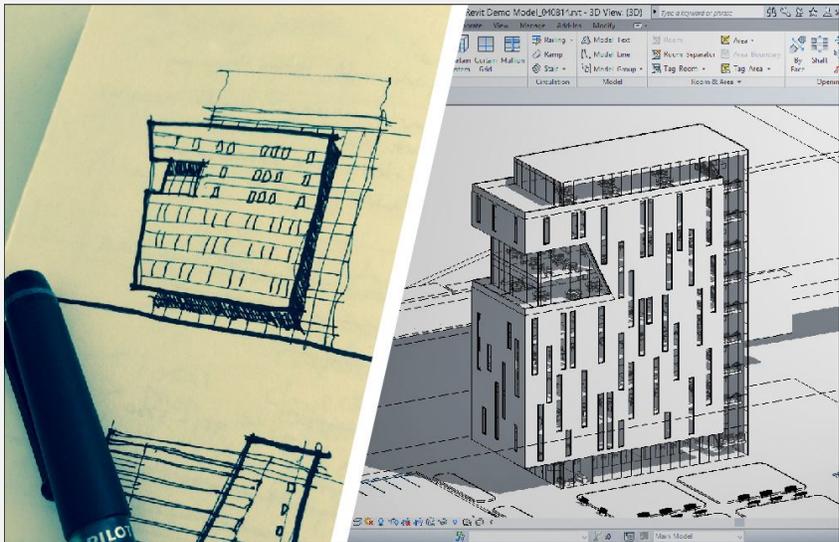
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1. Get more out of BIM

How many of you are currently using BIM?

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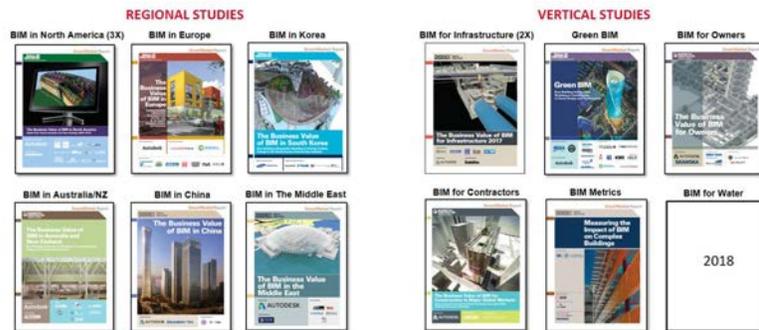
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1. Get ~~more out of~~ **BIM!!!**

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1. Get more out of BIM

- Stop thinking of BIM as something used IN YOUR FIRM
- Start thinking of BIM as something used ON YOUR PROJECTS

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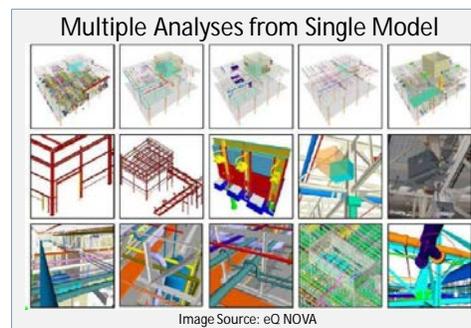
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1. Get more out of BIM

"Silos of Excellence" do not help



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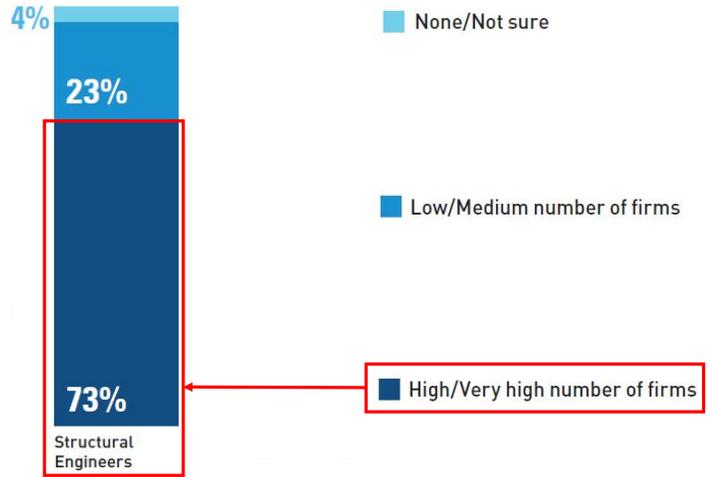
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1. Get more out of BIM

- Drive more adoption and use among your project team members
 - Where are we now re: engineers BIM adoption?
-

Architects' Perception of BIM Adoption by Engineers

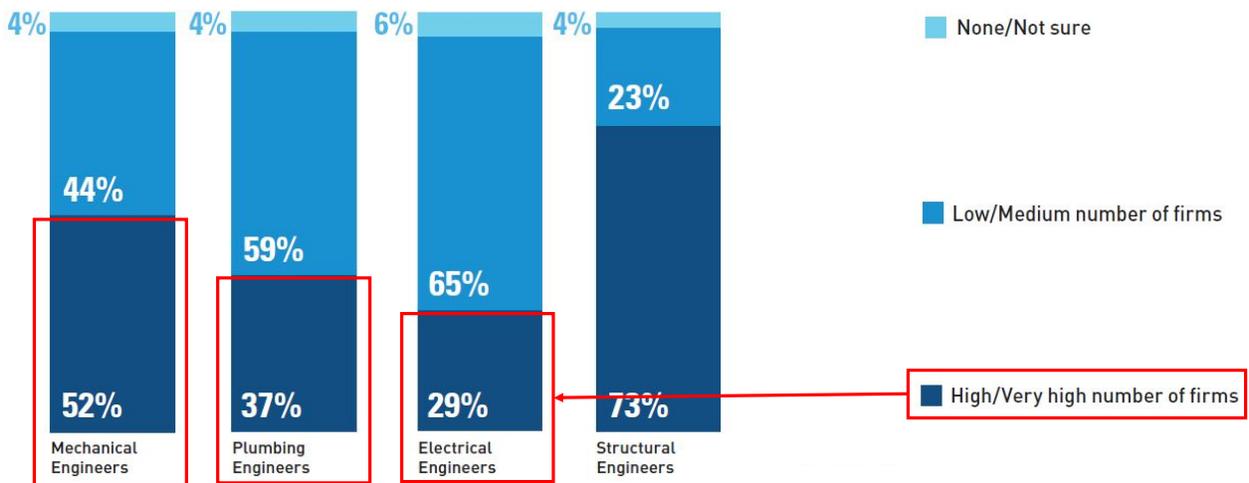
Percentage of architects who perceive each of three levels of BIM adoption in their market among five types of engineering firms



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Architects' Perception of BIM Adoption by Engineers

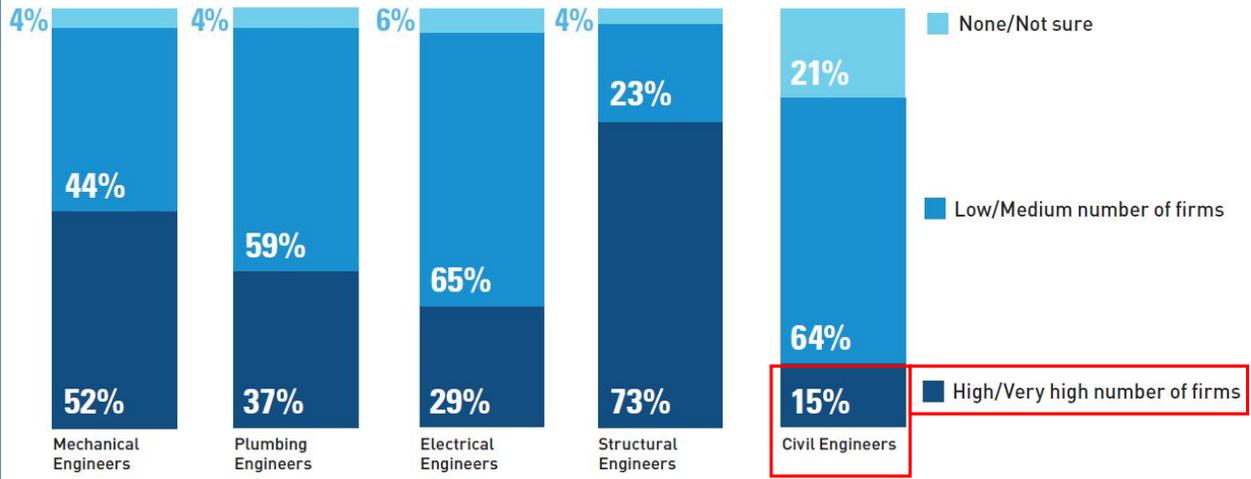
Percentage of architects who perceive each of three levels of BIM adoption in their market among five types of engineering firms



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Architects' Perception of BIM Adoption by Engineers

Percentage of architects who perceive each of three levels of BIM adoption in their market among five types of engineering firms



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Reality-informed design



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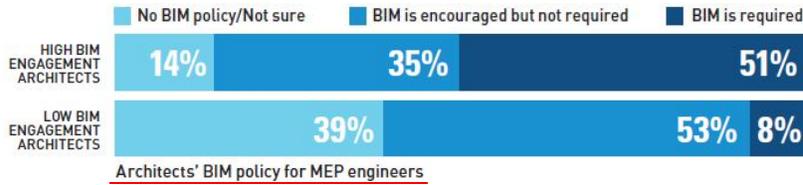
The **NEXT**

1. Get more out of BIM

- Drive more adoption and use among your project team members
- **HOW?** BIM Requirements

Architects' BIM Policies for Engineers

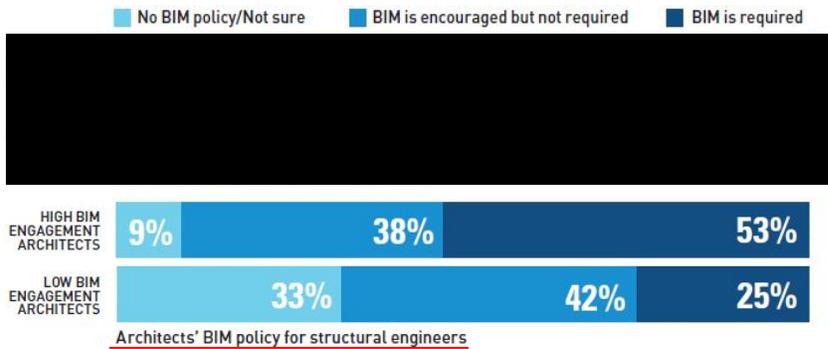
Percentages of architects reporting each of three levels of BIM requirements policy for engineering firms on their project teams



Dramatic differences between High and Low Engagement BIM users.

Architects' BIM Policies for Engineers

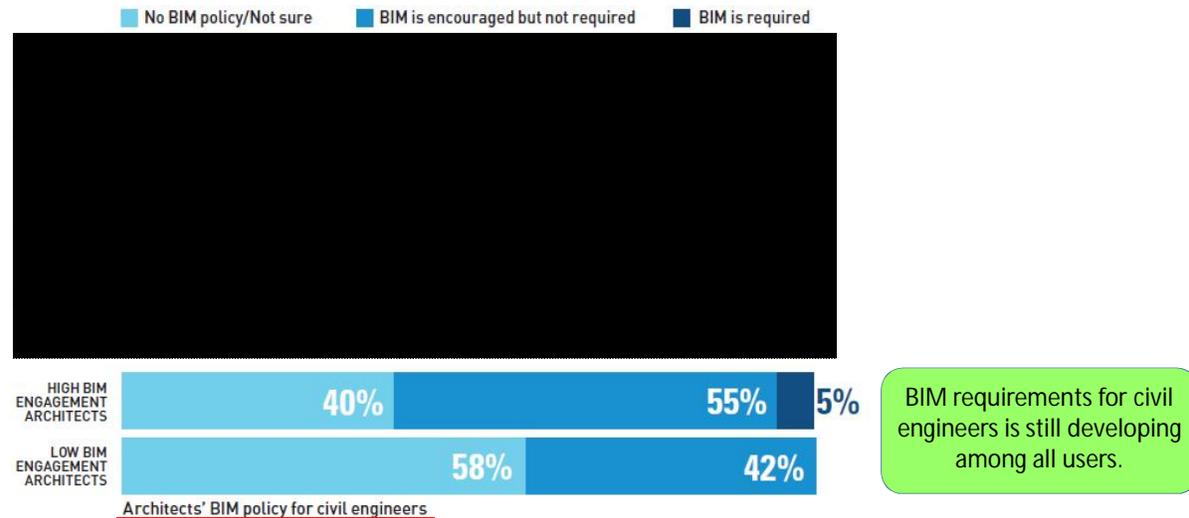
Percentages of architects reporting each of three levels of BIM requirements policy for engineering firms on their project teams



More of the Low Engagement users report having BIM requirements for structural engineers.

Architects' BIM Policies for Engineers

Percentages of architects reporting each of three levels of BIM requirements policy for engineering firms on their project teams



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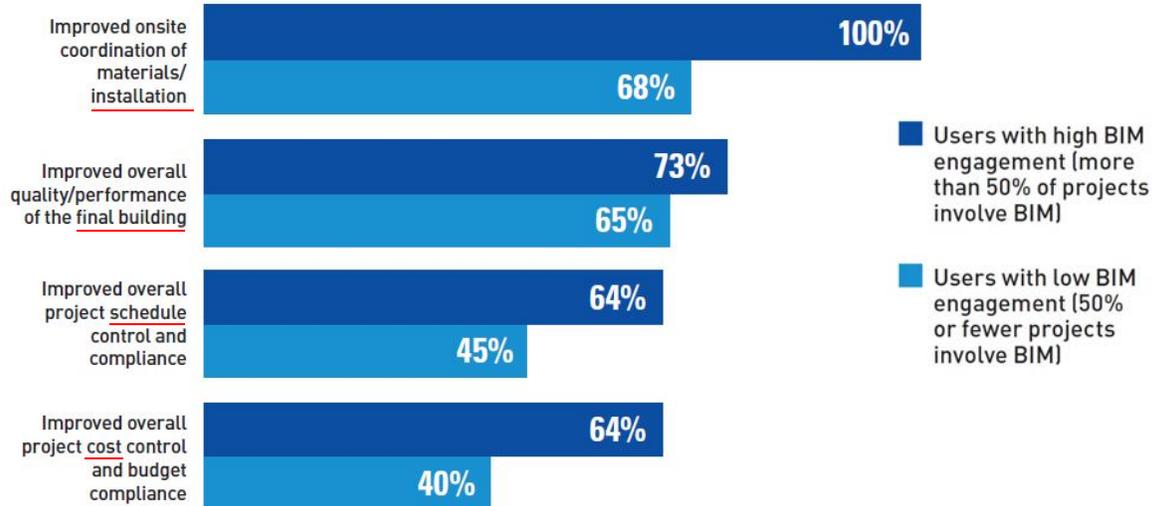
1. Get more out of BIM

- Drive more adoption and use among your project team members
- **WHY?** Better Outcomes

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Improved Project Outcomes When BIM is Used by Engineers and Trades

Percentage of BIM users who cite each of four benefits generated by having key team members engaged with BIM



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2. Drive integrated digital workflows

Continuous multi-party flow of digital data

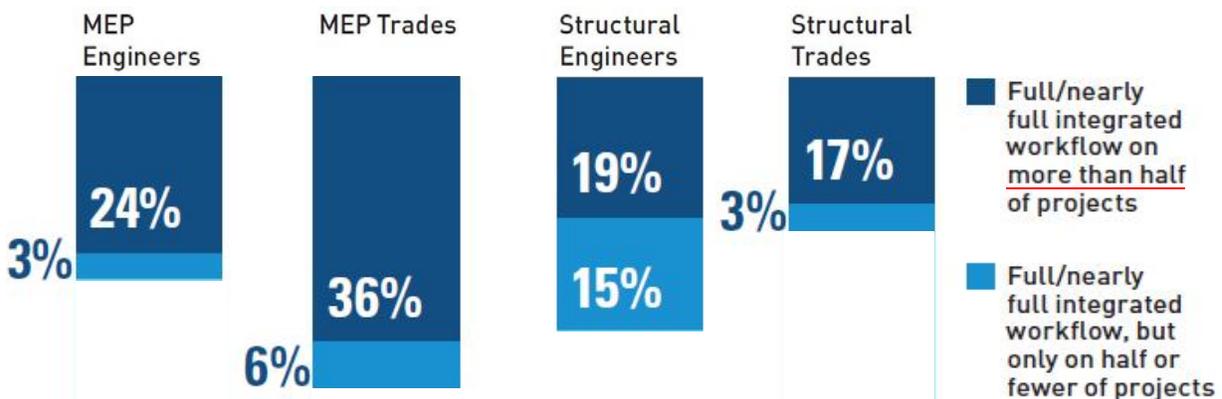
- **Designers** – create model, code check, analyze/optimize
- **Detailers** – shop drawings, install/erection plans
- **Fabricators** – bring model data into fabrication systems
- **Installers** – Transfer data back into design model to validate accuracy and confirm installation in the field

Connecting design+fabrication+installation

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Frequency of Integrated Workflow

Percentage of structural and MEP engineers and trades who report participating in an integrated digital workflow on current and recent projects



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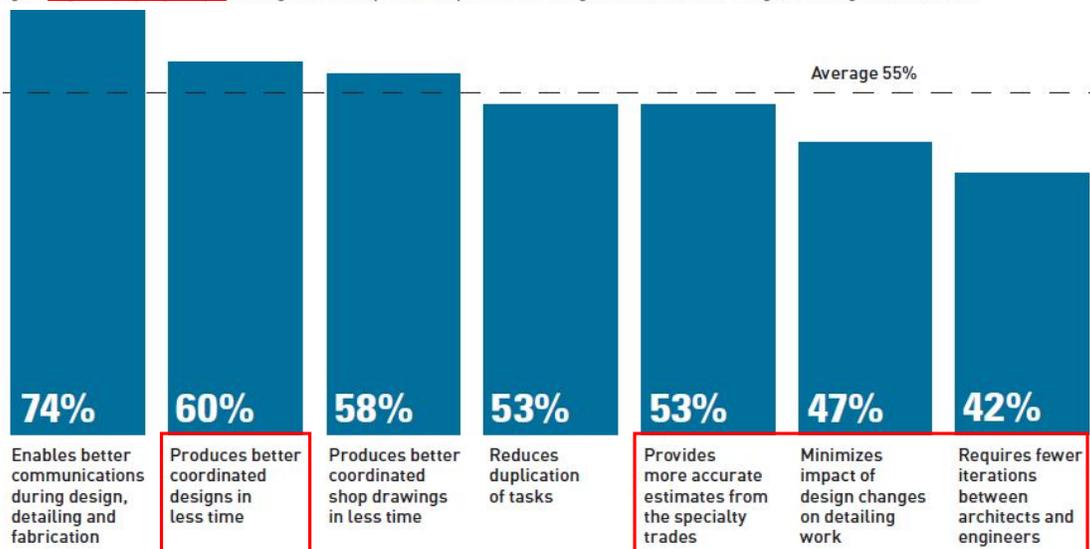
2. Drive integrated digital workflows

- **WHY?** Better Outcomes

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Impact on Design, Detailing and Fabrication

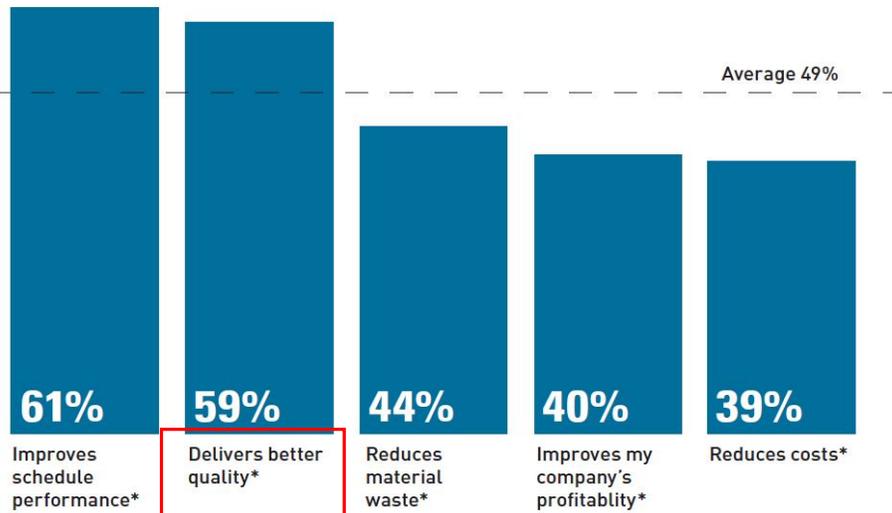
Percentage of *high or very high impact* ratings for seven positive impacts of the integrated workflow on design, detailing and fabrication



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Impact on Project Outcomes

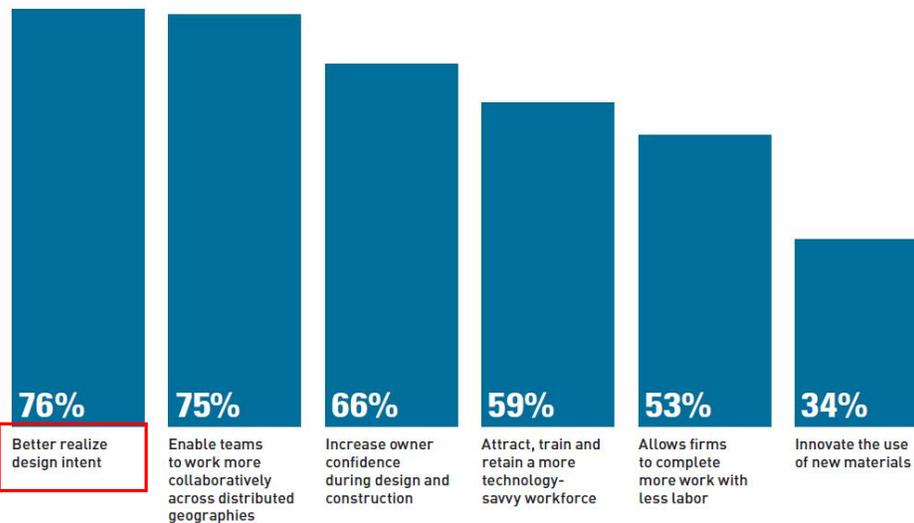
Percentage of high or very high impact ratings for 5 positive impacts of the integrated workflow on project outcomes



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Predicted Future Benefits of Integrated Workflow

Percentage of respondents who predict high or very high impact in the future for each of 6 positive impacts of the integrated workflow



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Most Impactful BIM Trends and Capabilities in the Next 5 Years

Percentages of each discipline that predict high or very high positive impact for emerging BIM trends or capabilities over the next five years

	Architects	Structural Engineers	MEP Engineers	GC/CMs	Structural Trades	MEP Trades
Tools that allow visual and creative insight to produce better design alternatives in less time	83%	78%	45%	70%	70%	76%
Intelligent models that lead to more consistent and coordinated contract deliverables	77%	72%	52%	67%	67%	73%
BIM-based processes that produce better coordinated shop deliverables in less time	77%	72%	48%	73%	70%	67%
Single source of truth of project data, accessible anytime, anywhere in the office, shop or field	73%	66%	55%	53%	73%	70%
Integration of analysis and code-based design with 3D models*	63%	66%	48%	47%	53%	61%
Ability to visually simulate project delivery timelines for estimation and coordination	52%	63%	39%	53%	57%	61%

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3. Embrace generative and computational design

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Commonly used in product design

- *set parameters and constraints*
- *the computer analyzes 1000's of feasible options*

Optimize the solution
within parameters
and constraints

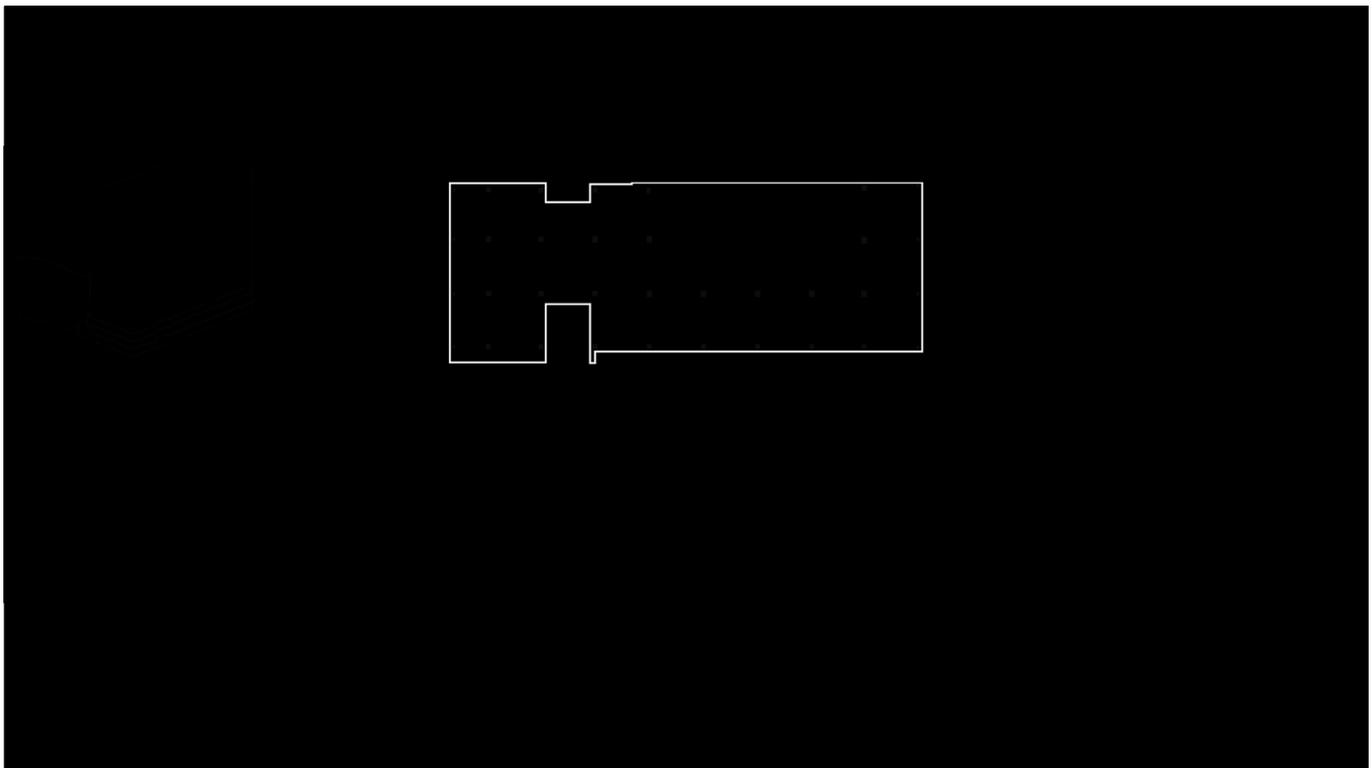
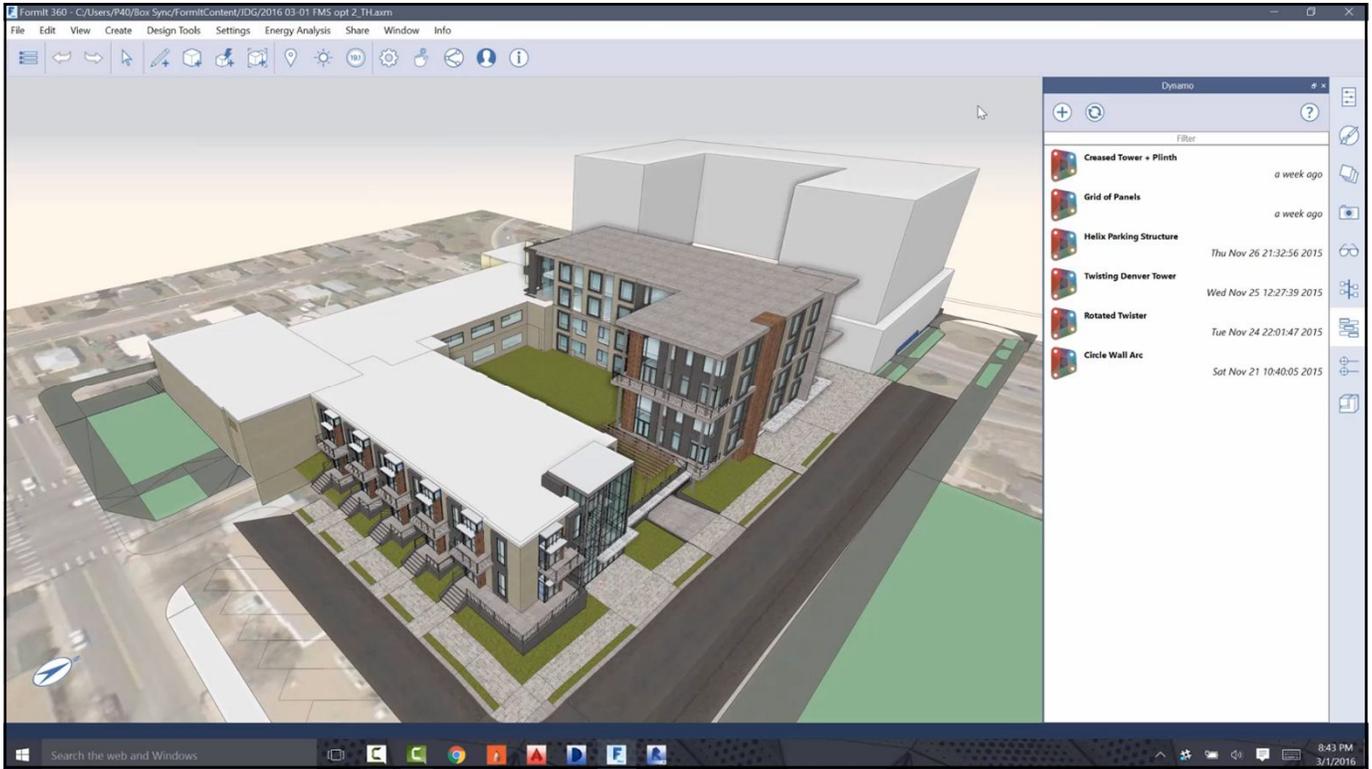


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Insight Capabilities for Generating Design Options

1	Early-stage sketching that connects conceptual design to BIM with smart objects that flow into later stages of design
2	Early-stage sketching that uses constructability constraints and building-code requirements to drive geometry and behavior of design models
3	Creating visual logic to explore parametric conceptual designs and automate tasks
4	Using generative design to cycle through thousands of design choices, testing configurations and developing more sophisticated solutions through multiple iterations
5	Incorporating reality capture to document existing conditions more accurately
6	Integrating design options with GIS data to more fully represent the contextual environment

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Computational Design & Construction
Parking Garage Configurator



Sale | Client | Concept model



Explore | Alternatives | Optimization

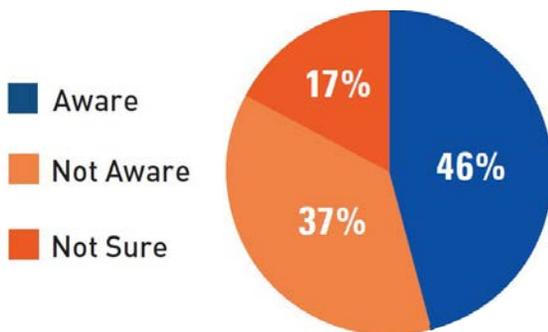


Documentation | Detail | BIM model

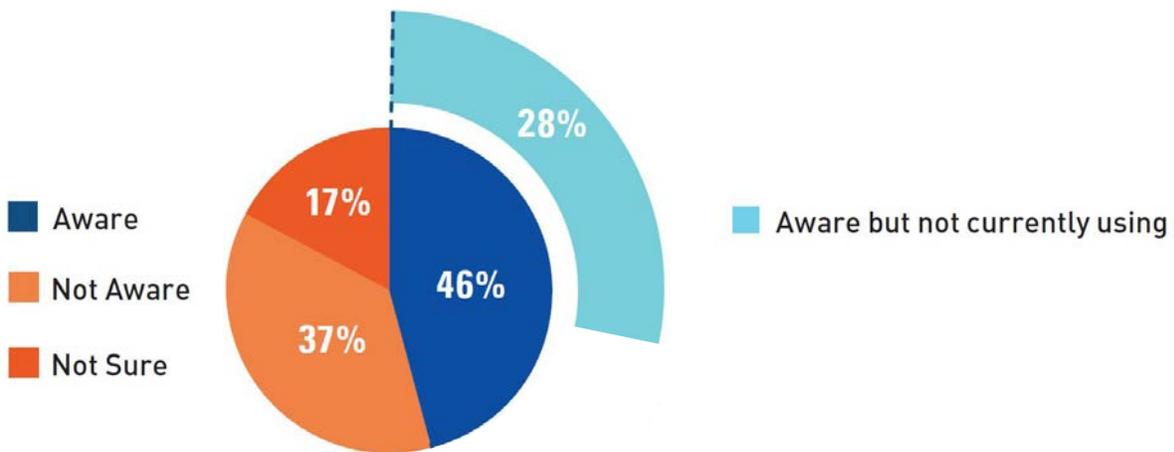


Construction Planning & Execution

Awareness and Use of Generative Design

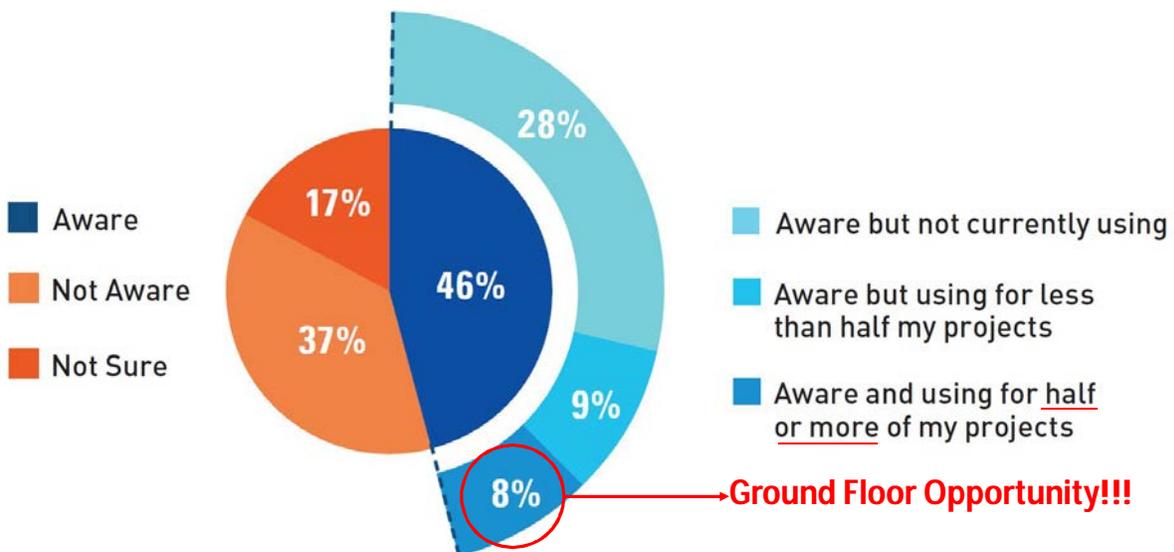


Awareness and Use of Generative Design



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Awareness and Use of Generative Design



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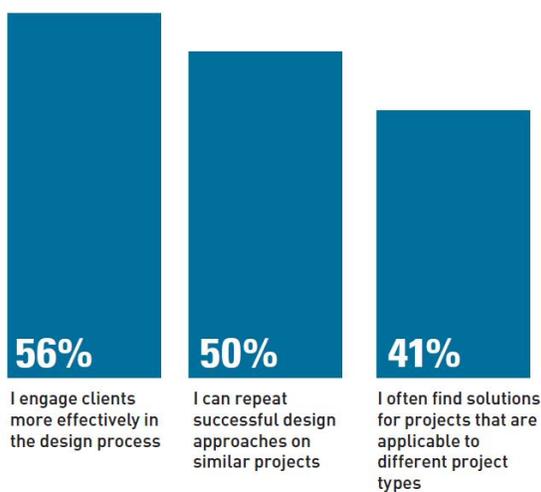
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3. Embrace generative and computational design

- **WHY?** Better Outcomes

Impact on Design Process

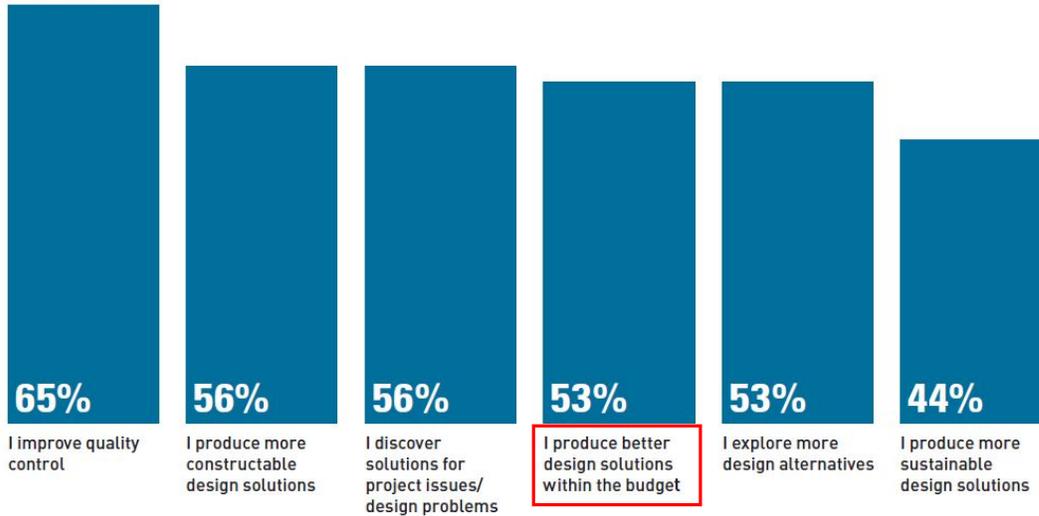
Percentage of users reporting high or very high level of benefit



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Impact on Design Solutions

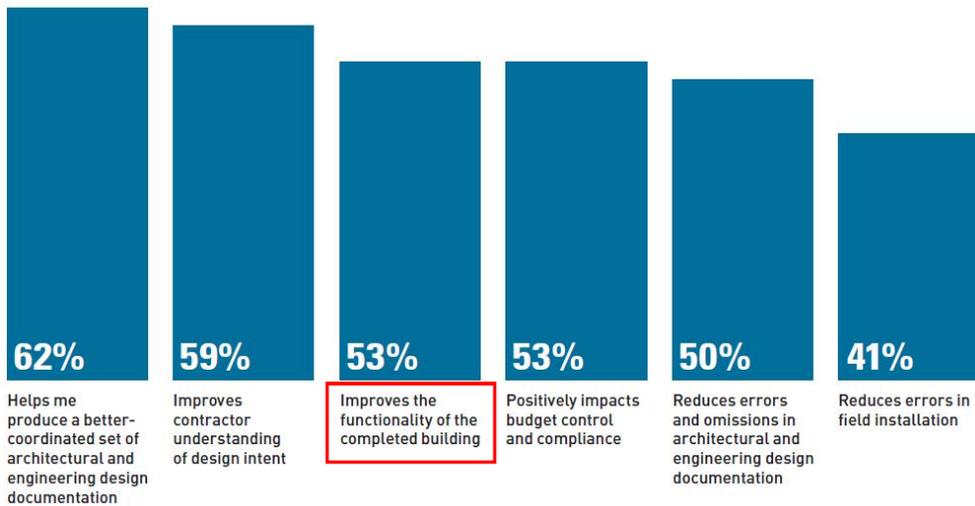
Percentage of users reporting high or very high level of benefit



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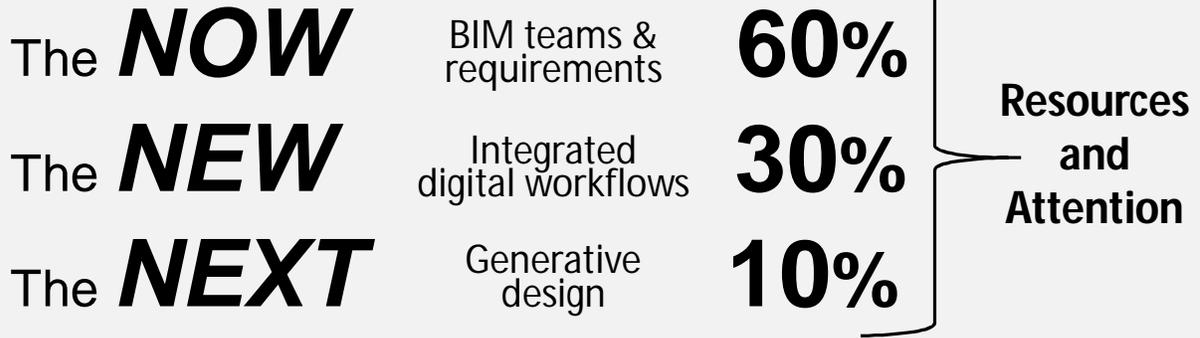
Impact on Production, Construction and Operation

Percentage of users reporting high or very high level of benefit



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TECHNOLOGY/INNOVATION



SUSTAINABILITY



PRACTICES/PROCESSES



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Thank you!

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Town Hall Discussion

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Town Hall Discussion

Stephen Hagan FAIA

- President | CEO, Hagan Technologies
- Principal, Construction Data Ventures

Kimon Onuma FAIA

- President, Onuma, Inc.

Jonathan Widney

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Steve Jones

- Senior Director, Dodge Data & Analytics



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Architecture

as a Platform for the Urban Agenda

6/21/2018 9:45 AM - 11:15 AM

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Thank you!

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Harness the Technology Innovation Revolution

Course Number TH204

Thursday, June 21, 2018, 7:30 AM – 9:00 AM

Learning Units 1.5 LU RIBA

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